PRELIMINARY ASSESSMENT/SITE INSPECTION
PALZO MINE SITE

U.S.D.A. FOREST SERVICE
SHAWNEE NATIONAL FOREST

T N & Associates, Inc.
Engineering and Science
1033 N. Mayfair Road, Suite 200
Milwaukee, WI 53226

Final: March 14, 2002

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF SE-4J

resent: September 26, 2002

Mr. William Mains
Environmental Engineer
USDA-Midewin
30071 South SR53
Wilmington, IL 60481

Subject: Palzo Mine Site, Shawnee National Forest
Williamson County, Illinois

Dear Mr. Mains:

As requested by the U.S. Environmental Protection Agency (U.S. EPA) has reviewed the Palzo Mine Site preliminary assessment/site inspection (PA/SI) report prepared for the U.S. Department of Agriculture - Forest Service (Forest Service) (TN & Associates, Inc. [TN&A] 2002). U.S. EPA has evaluated the PA/SI report to determine whether and to what extent contamination from former strip mine activities on the Palzo Mine Site poses a threat to human health and the environment.

This letter summarizes U.S. EPA's findings and provides some recommendations as far as data gaps that we would like to see addressed. Specifically, this letter is organized in the following sections:

- Site Background
- Reclamation Activities
- Previous Investigations
- Conclusions and Recommendations

SITE BACKGROUND

Palzo Mine covers about 312 acres in the Shawnee National Forest in Williamson County, Illinois. About 270 acres of the 312-acre site was strip-mined from the late 1950s to the early 1960s by Stonefort Mining Company (Stonefort). Presently, the volume of mine waste (spoils) deposited on the site is 4,500,000 cubic yards. The Forest Service acquired the surface estate of the site in 1966; however, site mineral rights are held by Peabody Coal, which acquired Stonefort.

During the strip mining process at the site, pyritic shale (containing about 4 percent sulfur) was excavated and consequently exposed to oxygen, water, and bacteria at the surface. As the pyrite oxidizes, sulfuric acid is produced, and metals within the spoils are dissolved into groundwater and surface water. This process results in acid mine drainage (AMD), which is characterized by low pH values and high concentrations of metals. AMD has been documented in groundwater and surface water at the site. AMD from the Palzo Mine Site and other strip mines in the area has resulted in the Illinois Department of Natural Resources' designation of Sugar Creek and the South Fork of the Saline River as "non-supportive" of biotic life for 30 miles of their runs, including adjacent to and downstream of the Palzo Mine Site. Sugar Creek borders the site to the north and discharges to the South Fork of the Saline River about 2 miles downstream of the Palzo Mine Site.

concentrations significantly greater than background levels. No sensitive species were identified at the site during the biological survey. The PA/SI conclusions included the following: (1) groundwater has characteristics similar to those of AMD as deep as 39 feet below ground surface in the pyritic shale underlying the site, (2) surface water drainages south of the site are impacted by AMD-contaminated groundwater discharging to the surface, and (3) nearby private water wells located southeast and southwest the site may be affected by AMD-contaminated groundwater from the site.

CONCLUSIONS AND RECOMMENDATIONS

Several data gaps exist with regard to the site, including the following: (1) there has not been an adequate characterization of groundwater flow at the site; (2) potential contamination of off-site, private drinking water wells located less than ¼ mile southeast and southwest of the site has not been investigated; (3) no sample analytical results are available for the complete target analyte list for groundwater throughout the site, and no background groundwater sampling location is available; and (4) no characterization of on-site soil has been performed. U.S. EPA recommends that the groundwater in off-site, private wells be analyzed for all constituents on the target analyte list as well as pH. U.S. EPA also recommends that a soil investigation be performed at the site. Because additional site reclamation activities are planned in the summer of 2002, any additional on-site investigations may be more valuable if they are conducted subsequent to these activities.

In addition, U.S. EPA received a letter from the Forest Service dated July 26, 2002 from Tim Buxton, the On-Scene Coordinator for this facility. This letter states that the Forest Service does not plan to implement a response action but that the IDNR Abandoned Mined Lands Reclamation Division will be addressing the Palzo Mine Site, with funding in part provided by the Illinois Environmental Protection Agency under Section 319 of the Clean Water Act. As the Forest Service is the owner and operator of the Palzo Mine Site, U.S. EPA will expect to receive any new information regarding the response and additional investigations on the Palzo Mine Site by IDNR Abandoned Mined Lands Reclamation Division from the Forest Service.

If you have any questions regarding this letter, please call me at (312) 886-6040.

Sincerely,

Laura J. Ripley

Laura Ripley, Environmental Scientist
Superfund Division
Brownfield Early Action Section

cc: Sandy Anagnostopoulos, Tetra Tech START Project Manager

United States Department of Agriculture | Forest Service | Eastern Region | 310 West Wisconsin Ave. Suite 580 Milwaukee, WI 53203

File Code: 2160
Date: July 26, 2002

Ms. Laura Ripley
Site Assessment Manager
USEPA - Region 5
77 West Jackson Blvd.
Chicago, IL 60604

Dear Ms. Ripley;

This letter follows up on a December 29, 2000 *Federal Register* notice of the addition of the "Palzo Mines Site, Shawnee National Forest" to the Federal Facility Hazardous Waste Compliance Docket, and on a June 15, 2001 request from your office for the Forest Service to conduct a Preliminary Assessment/Site Inspection (PA/SI) at the Site. In response to these items, Bill Mains of the Forest Service delivered the PA/SI for the Palzo Mine Site to your office on April 24, 2002.

Based on current information, the Forest Service does not plan to implement a response action at the Palzo Mine Site. Under the National Contingency Plan, the lead agency may conclude that a removal action is not necessary because other appropriate federal or state response mechanisms are responding to the release (40 CFR 300.415(b)(2)(vii)). Here, another party is providing appropriate response. Specifically, the Illinois Department of Natural Resources Abandoned Mined Lands Reclamation Division is addressing the Site, with funding in part provided by the Illinois Environmental Protection Agency under Section 319 of the Clean Water Act.

Please contact me at the Mark Twain National Forest, Potosi/Fredericktown Ranger District, P.O. Box 188, Potosi, Missouri 63664, or at (573) 438-5427, if I can be of further assistance on the Site.

Sincerely,

TIM BUXTON
On-Scene Coordinator

cc: Ron Kiser, IDNR-AMLRD
Nick Giannettino, District Ranger, Shawnee National Forest
Forrest Starkey, Forest Supervisor, Shawnee National Forest
Fred Hintsala, Eastern Regional Office CERCLA Coordinator
Kirk Minckler, USDA-OGC Mountain Regional Office

John A Taylor/R9/USDAFS <jataylor02@fs.fed.us>

08/28/02 05:13 PM

To: LAURA RIPLEY/R5/USEPA/US@EPA
cc: Tim Buxton/R9/USDAFS <tbuxton@fs.fed.us>, Nick Giannettino/R9/USDAFS <ngiannettino@fs.fed.us>, Bryan C Fitch/R9/USDAFS <bfitch@fs.fed.us>, William Mains/R9/USDAFS <wmains@fs.fed.us>
Subject: PalzoMine.aw

(See attached file: PALZOMINE.doc)
Please review the attached response.

PALZOMINE.d

United States Department of Agriculture | Forest Service | Shawnee National Forest | 50 Highway 145 South
Harrisburg, IL 62946
800-699-6637
TTY 618-253-1070

File Code: 2820

Date: August 28, 2002

U.S. Environmental Protection Agency
Brownfield Early Action Section
Attn: Laura Ripley, Environmental Scientist
77 W. Jackson Blvd
Chicago, IL 60604

Dear Ms. Ripley:

This information responds to your question related to the Palzo Mine that was not included in the PA/SI report. Please note that the Palzo Mine is located in rural southern Illinois and not within the limits of any City, Town or other community.

PALZO MINE

- This site is located in Stonefort Township (T10S-R4E SE1/4, part of the S1/2NE1/4, SENW, NESW, and part of the SESW Section 16), Williamson County, Illinois.
- The Federal parcel occupied by the mine is estimated as 325.31 acres.
- The parcel is located 37.650 North latitude and 88.774 West longitude.
- The zip code for Stonefort Illinois is 62987.
- The parcel is within the 19th Congressional District. Honorable David Phelp, Representative.
- Access to the site is provided by Williamson County Road No. 12 (locally known as the Springhill Church Road).

Please respond if additional information is needed.

Sincerely,

/s/ John Taylor
JOHN TAYLOR
Forester

PRELIMINARY ASSESSMENT/SITE INSPECTION
PALZO MINE SITE

U.S.D.A. FOREST SERVICE
SHAWNEE NATIONAL FOREST

Prepared for:
USDA-FOREST SERVICE
Shawnee National Forest
Vienna Ranger District
Vienna, Illinois

Contract No. 53-569R-0-1346
Task Order No. 43-51KN-0-1431
TN&A Project No. 2001197

Prepared by:
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TN&A: Nova Clite, Hydrogeologist/Project Manager — Date 3/14/02

TN&A: Rose M. Chmielewski, Ecologist — Date 3/14/02

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ACRONYMS AND ABBREVIATIONS

AMD	acid mine drainage
AMLRD	Abandoned Mine Land Reclamation Division
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
DO	dissolved oxygen
GPS	global positioning system
IAC	Illinois Administrative Code
IDNR	Illinois Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
INHD	Illinois Natural Heritage Database
INHS	Illinois Natural History Survey
ISGS	Illinois State Geological Survey
MCL	Maximum Contaminant Level
PA/SI	Preliminary Assessment/Site Inspection
ppm	parts per million
QA/QC	Quality Assurance/Quality Control
RFSS	Regional Forester's Sensitive Species
SARA	Superfund Amendments and Reauthorization Act
ST & SE	State Threatened and State Endangered species
TDL	Target Distance Limit
TDS	total dissolved solids
T&E	Threatened and Endangered
TN&A	T N and Associates, Inc.
U.S. EPA	United States Environmental Protection Agency
USFS	United States Department of Agriculture – Forest Service

1.0 INTRODUCTION

T N & Associates, Inc. (TN&A) has prepared this report for the United States Department of Agriculture - Forest Service (USFS) in accordance with Contract No. 53-569R-0-1346 (US SBA 8(a) Contract No. 0543-00-001659), Task Order No. 43-51KN-0-1431. The purpose of this report is to document the findings of the Preliminary Assessment and Site Inspection (PA/SI) of the Palzo Mine Site ("Palzo" or "the Site") in the Shawnee National Forest.

TN&A performed the PA/SI consistent with the latest edition of the United States Environmental Protection Agency (U.S. EPA) *Guidance for Performing Preliminary Assessments under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)(1991)*; *Guidance for Performing Site Inspections Under CERCLA (1992), Sampling Quality Assurance/Quality Control (QA/QC) Plan and Data Validation Procedures*; CERCLA; the Superfund Amendments and Reauthorization Act (SARA); and the National Contingency Plan as outlined for PAs in 40 Code of Federal Regulations (CFR) Parts 300.410(c) (1)(i-v).

The purpose of this PA/SI was to assess immediate or potential future threats to human health or the environment of releases from this former coal mine Site. The USFS will use the information collected during the PA/SI to support a decision regarding the need for further action(s) under CERCLA and SARA. A preliminary biological survey of the Site is also incorporated into this report.

2.0 SITE DESCRIPTION, OPERATIONAL HISTORY, AND WASTE CHARACTERISTICS

2.1 Site Location

The Site is located in the Shawnee National Forest in Williamson County, Illinois (Figure 1). The Site is located in southern Illinois in the southeast corner of Williamson County (Section 16, Township10 South, Range 4 East), approximately 6.5 miles southeast of Marion, Illinois and 3 miles northwest of Stonefort, Illinois (Figure 1). The Site is bounded on the north by Sugar Creek, by Bost Orchard Road on the south, County Highway 12 (County Highway 12) on the east, and by private property on the west (Figure 1). The Site is accessed by driving east of Marion, Illinois on State Highway 13 for approximately 10 miles to Crab Orchard, Illinois; turning right onto Crab Orchard Road and proceeding east approximately 1 mile to State Highway 12; turning right onto Highway 12 and proceeding south for approximately 6.5 miles. Approximately ½ mile after crossing Sugar Creek, the gated entrance to the Site can be found on the right.

The Site is comprised of approximately 312 acres of which 270 were strip-mined and are in the process of or have been reclaimed.

2.2 Site Description

2.2.1 Physical Characteristics

The Site lies within the Greater Shawnee Hills physiographic province. The area was not glaciated and therefore is characterized by rugged topography with many bluffs and ravines. The soils in this region were derived from wind-blown loess and are well developed (IEPA, 1993). The uppermost bedrock consists of the Spoon Formation, a Pennsylvanian-age interbedded sandstone with coal and shale (Table 1). Two coal seams were mined at the Site: the Dekoven (upper seam) and the Davies (lower seam). A layer of black pyritic fissile shale separated these two seams. A summary of the Site geologic strata is provided in Table 1.

The surface area of the Site can be divided into thee areas: perimeter areas that were undisturbed by mining (44 acres), the area where only the uppermost coal seam was removed (60 acres), and the area where both coal seams were removed (207 acres) (Figure 2) (USFS, 1972). Mining began in the center portion of the Site and proceeded outward. (Aerial photographs of the Site prior to and during the course of mining activities are provided in Appendix A.) The coal was mined by surface strip-mining methods in which a dragline scraped off the overburden and cast it aside in an elongated spoil pile. The method produced a mixture of topsoil, sandstone bedrock, and black pyritic shale. The first area was mined down to the top of the pyritic shale. In subsequently mined areas, both coal seams were removed and the intervening pyritic shale became part of the mine spoils. The mine spoils were retained on the Site within the mined areas (Figure 3).

Surface soil at the present time is highly variable and not representative of natural conditions. A 1998 study completed by Indeco, Inc. for the Illinois Department of Natural Resources (IDNR) found that most surface soils consisted of a mixture of brown clay, coal fragments, sand, sandstone and black shale fragments (Indeco, 1998).

2.2.2 Climate

Site climate data were obtained from the Illinois State Climatologist Office, which has a monitoring station at the Carbondale Sewage Plant in Carbondale, IL (about 25 miles west of the site) (IDNRa, 2002), Southern Illinois has warm, rainy summers and relatively mild winters. The average cold season (November – April) temperature is 42°F, ranging from 30°F to 56°F. During the warm season (May – October) the average temperature is 70°F, ranging from 57°F to 78°F. Rainfall is registered throughout both the summer and winter months with an average yearly precipitation of 45.9 inches. The region receives an average of 10.6 inches of snow per year.

2.2.3 Regional Hydrology

The Site is located within the Saline River drainage and the Ohio River watershed. The Saline River drainage covers 1,177 square miles (sq mi) and is divided into three sub-drainage systems:

the North Fork, the Middle Fork, and the South Fork, which drains 281 sq miles (IEPA, 1993) (Figure 3). Surface water and groundwater from the Site drains into Sugar Creek, then into the South Fork of the Saline River. Sugar Creek discharges to the South Fork approximately 3 stream-miles from the Site. The Saline River discharges to the Ohio River near Old Shawneetown, IL.

2.2.4 Local Populations and Land Use

The Site is located in a rural area and is surrounded by woodlands, farmland, and abandoned or reclaimed former strip-mine land. There is a church and cemetery located adjacent to the Site on its east boundary (on County Hwy 12); the church is located less than 100 feet from a reclaimed portion of the Site and approximately 300 feet from the area that is currently being reclaimed by IDNR Abandoned Mines Land Reclamation Division (AMLRD), see Section 2.4. A private residence is located within approximately 450 feet of the southwest Site boundary. There are no schools or daycare centers located within 200 feet of the Site (based on Site Inspection field observations).

There are approximately four residences within ¼ mile of the Site; assuming an occupancy rate of 2.35 persons per household, there are approximately 9 persons living within ¼ mile of the Site boundaries (Table 2) (U.S. Bureau of Census, 1990). There are an estimated 71 persons living within 1 mile, and 1,274 persons living within 4 miles of the Site (Table 2).

Land use in the South Fork drainage basin consists of 24.5% grassland, 24.2% cropland, 41.4% woodland, 4.4% mined lands, and 5.5% urban/other (IEPA, 1993). Mining, although it is a small percentage of land use, accounts for significant water quality degradation in the basin. According to the IEPA (1993) there are 11 former coalmines contributing acid mine drainage (AMD) to the streams of the South Fork drainage basin. The IEPA has concluded that the lower portion of the South Fork is virtually devoid of life due to AMD from old mines. The most notable of these mines are the Palzo and Old Will Scarlet mines (Old Will Scarlet Mine is located immediately north and east of the Site). Both of these mines discharge AMD directly to Sugar Creek.

2.3 Operational History

The Stonefort Mining Company mined the Site from the late 1950s through the early 1960s (Kiser, 2001). According to information provided by the USFS, the United States acquired the surface estate of the Site in 1966 from the Stonefort Mining Company. The mineral rights remain privately held by Peabody Coal, which bought the Stonefort Mining Co. At the time of acquisition, the Site contained approximately 192 acres of exposed acid spoil, 60 acres of naturally re-vegetated mined land, 15 acres of partially reclaimed land, 41 acres of undisturbed natural vegetation, and 4 acres of roads (USFS, 1972). The Shawnee National Forest administers the surface estate for the United States.

Historical aerial photographs (1951 – 1980) show phases of mining at the Site (Appendix A).

- The June 1951 aerial photograph shows that the Site was used for cropland and forest.
- The June 1960 aerial shows mining activities in the central part of the Site, which was mined November 1959 thru June 1960 (Nawrot, 1983).
- The October 1965 photograph shows the full extent of areas disturbed by mining. Re-vegetation of the central part of the Site is apparent in this photo.

Mining was completed at the Site by April 1961 (Nawrot, 1983). The subsequent aerials show some phases of the reclamation activities, which are discussed in the next section.

2.4 Prior Reclamation Activities

Mitigation of AMD was first attempted in 1972 by the USFS. Official notification was given to the USFS by the Illinois Sanitary Water Board on April 8, 1970 to correct the health and environmental hazard created by AMD at the Site (USFS, 1972). In response, the US Forest Service implemented the "Palzo Restoration Project" in 1975, The IDNR AMLRD has conducted three more restoration projects at the Site (Indeco, 1998).

- 1972-1974, Site grading was performed.
- 1975-1977, Palzo Restoration Project (Phase I Reclamation), Incorporation of Sludge obtained from the Metropolitan Sanitary District of Greater Chicago (MSDGC).
- 1985, Phase II Reclamation, Work entailed clearing, trash and debris removal; 285,000 c.y. earth excavation; 43,300 c.y. rock removal; ditch excavation; riprap placement; excelsior blanket; surface and deep lime incorporation; fertilizing; seeding; mulching and other site incidentals.
- 1986, Phase III Reclamation, Work entailed 960 c.y. earth excavation; trench treatment and backfill; riprap placement; earth dam construction; surface and deep lime incorporation; fertilizing; seeding; mulching and other site incidentals.
- 1987, Palzo Surface Mine Remedial Reclamation, Work entailed limestone incorporation; excelsior blanket; fertilizer; seeding; mulching and other site incidentals.

Indeco Inc., a contractor for IDNR AMLRD, performed an investigation to identify and delineate the causes and sources of AMD at the Site and to provide conceptual remedial alternatives and cost estimates for preventing continued impacts to Sugar Creek (Indeco, 1998).

The IDNR AMLRD was conducting a reclamation project at the time of the Site Inspection that included regrading of the central portion of the Site to remove windrowed spoil banks; removal of gabion baskets from western and northern drainages; and amendment of spoils with deep incorporation of limestone. The restoration that has and is occurring at the Site is focused on regrading the spoil piles to eliminate surface water ponds and to promote surface drainage

(IDNR, 1999). The regrading portion of the project was in progress when TN&A conducted the SI fieldwork in November 2001.

2.5 Source/Waste Description

The wastes consist of mine spoils that cover an estimated 267 acres at the Site. Mine spoils are present on all previously mined areas of the Site, as shown on Figure 2. Based on boring logs from the 1998 investigation, the average estimated thickness of waste on the northern half of the Site was 32 feet; on the southern half, 18 feet. Therefore, the estimated volume of mine wastes was 4.5 million cubic yards. The spoils are the primary source of AMD that has severely impacted surface water quality in the on-site tributaries and Sugar Creek.

During the mining process, pyritic shale (containing nearly 4% sulfur) was excavated and consequently exposed to oxygen, water and bacteria at the surface (Indeco, 1998). As the pyrite oxidizes (a process facilitated by bacteria), sulfuric acid is produced and metals within the spoils are dissolved into the water. This process produces AMD, which is characterized by low pH values and high concentrations of sulfate, iron, manganese and aluminum (Rose et al, 1998). Surface water and groundwater samples from the Site collected during the SI indicate the presence of AMD, as discussed in Section 3.0.

3.0 PATHWAY AND ENVIRONMENTAL HAZARD ASSESSMENT

3.1 Site Inspection Summary

In November 2001, TN&A conducted the SI including collection of samples for field and laboratory analyses. Water samples were collected from on-site drainages, surface water impoundments, monitoring wells, and Sugar Creek for laboratory analysis of target metals (aluminum, antimony, arsenic, beryllium, cadmium, calcium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, thallium and zinc) and wet chemistry parameters (acidity as CaCo3, alkalinity CaCo3, hardness, sulfate and sulfide). The samples were also field-analyzed for pH, conductivity, turbidity, dissolved oxygen (DO), temperature, total dissolved solids, oxidation-reduction potential, iron, and manganese. Iron and manganese were evaluated using colorimetric field test kits. All sampling locations were surveyed using global positioning system (GPS) techniques. All SI fieldwork was performed in accordance with the approved SI Work Plan (TN&A, October 2001).

SI sampling locations are shown on Figure 4. Photographs documenting the Site are presented in Appendix B. Laboratory analytical results for SI samples are presented in Appendix C, along with a laboratory data quality statement.

3.2 Ground Water

3.2.1 Site Hydrogeology

Groundwater conditions at the Site were described in the 1998 site investigation report (Indeco, 1998). Depth to groundwater (in the shallowest aquifer) is approximately 9 feet. Groundwater flow was inferred by Indeco to be east-northeast, based on groundwater levels in 14 monitoring wells (Figure 4). However, based on the Site topography, groundwater would be expected to flow radially outward from the topographic highs on the Site (Figure 4). Radial groundwater flow is supported by SI field observations of groundwater seeps flowing from the south, west and north sides of the Site (Figure 4). The Indeco report did not include an evaluation of groundwater flow characteristics on the south side of the Site because they had no monitoring wells installed. The lack of groundwater data on the south side represents a significant data gap because the nearest private wells are located southeast and southwest of the Site.

3.2.2 Water Supply Wells

To determine groundwater use within the 1-mile and 4-mile radii of the Site, TN&A accessed the Illinois State Water Survey private well database (IDNRb, 2002). The database provides information on private wells on a Township, Range, and Section level. Well information from the database is presented in Appendix D. Well locations are shown on Figure 5.

Using the database and USGS quadrangle maps, 39 private wells were identified within a 4-mile radius of the Site (Figure 5). The majority of the private wells (29 of 39) are located south of the Site where the land was not mined.

- ¼ Mile Radius = 3 wells
- 1 Mile Radius = 3 wells
- 4 Mile Radius = 33 wells

Based on the state database, there are three private wells located within approximately 400 feet of the Site. One of these wells is at the private residence on Bost Orchard Road, adjacent to the Site, approximately 400 feet southwest of the Site. Two wells are located approximately 400 feet east of the Site in a group of residences east of County Highway 12. There are other private residences in the area near the Site that were noted during the SI; however, the database did not include well information for these homes. In addition, it is possible there is a well at the church and cemetery (located on the east Site boundary), but again no information was available in the state database, No water quality data are available for these water wells, The closest municipal well system is in Junction, Illinois more than 30 miles from the Site (Legon, 2001).

Indeco reported that the groundwater flow direction is east-northeast into Sugar Creek. However, as stated earlier, a radial groundwater flow pattern from topographic highs is suspected. Therefore, wells located near the Site to the south, southwest or southeast could potentially be

impacted by AMD-contaminated Site groundwater. No off-site groundwater quality data were obtained during this PA/SI.

3.2.3 Groundwater Sampling and Results

Prior investigations indicated that groundwater at the Site has been impacted by AMD (Indeco, 1998). The 1998 site investigation included sampling of 14 on-site groundwater-monitoring wells (There are no background wells at the Site). Indeco analyzed the samples for aluminum, manganese, sulfate, sulfide, alkalinity and acidity. The pH in groundwater samples from on-Site monitoring wells ranged from 7.16 (MW-6) to 3.8 (MW-11) (Indeco, 1998). The groundwater iron concentrations ranged from 14.50 milligrams per liter (mg/L) in MW-6 to 1,207.5 mg/L in MW-11 (Indeco, 1998).

During the SI, field parameters were measured at three on-site monitoring wells (MW-8, MW-10 and MW-11 as shown on Figure 4) and one sample was collected from MW-10 for laboratory analyses of the target parameters. These wells were selected to evaluate groundwater conditions at the central portion of the Site (groundwater at the perimeter areas was evaluated at various seeps). MW-11 is completed at 39 feet below ground surface (bgs) in the pyritic shale. Both MW-8 and MW-10 are shallow wells completed in unconsolidated materials (mine spoil).

Of the wells present on the site, none were considered to be in a hydrologically upgradient position relative to the mine spoils, Therefore, no groundwater background data is available at the site.

A visual inspection of the wells during sampling activities indicated the wells were generally in good condition; therefore groundwater quality data from these wells is probably reliable. Field screening results and laboratory results are summarized in Table 2.

A key indicator of AMD is negative net alkalinity (also called positive net acidity), which indicates that there is greater acidity present then can be buffered by the natural alkalinity of the solution (Rose et al, 1998). Net alkalinity is measured as alkalinity minus acidity (as measured by laboratory analyses of water samples), The primary indicators of AMD impacts in groundwater are low pH, relatively high concentrations of sulfate, iron, manganese, and aluminum, and negative net alkalinity.

The groundwater sample from MW-10 has AMD characteristics including low pH (4.38), negative net alkalinity (-630 mg/L), and relatively high concentrations of sulfate (1,700 mg/L), aluminum (100 mg/L), iron (110 mg/L), and manganese (34 mg/L). AMD characteristics in samples from MW-8 and MW-11 include low pH (2.9 and 2.45, respectively) and high conductivity and total dissolved solids (TDS). The field screening results at MW-11 indicate that AMD is either forming in or has migrated into bedrock at the Site.

Groundwater exhibiting AMD characteristics in the MW-10 sample had concentrations of beryllium, cadmium, and thallium greater than the federal Maximum Contaminant Levels (MCLs) (Table 3).

3.3 Surface Water

3.3.1 Site Hydrology

The Site drains to Sugar Creek, which flows east/northeast to its confluence with the South Fork, approximately 3 miles from the Site (Figure 6). Sugar Creek has an estimated flow of 10 – 100 cubic feet per second (cfs) and is approximately12 miles long. In its upper reaches, Sugar Creek drains primarily forested and agricultural land. Beginning approximately 2 miles upstream from the Site, Sugar Creek drains approximately 1,300 acres of formerly mined land (along 6 stream miles) including the Site. Sugar Creek discharges to the South Fork of the Saline River, which has an average annual flow rate of 161 cfs (IEPA, 1993).

The Site is situated on the south bank of Sugar Creek. On-site drainages and seeps discharge directly to Sugar Creek. Surface water, originating as precipitation and groundwater seeps, flows through four intermittent streams draining northward and two intermittent streams draining southward. In addition, two small drainages west of the West Tributary also discharge into Sugar Creek on the Site (far northwest corner).

The two northern drainages, identified as the Northeast Drainage and West Tributary (Figure 4) in this report, are fed by surface run-off and groundwater seeps (observed during the SI). The West Tributary flows north to northeast along the western border of the Site and outflows to Sugar Creek in the northwest corner of the Site. Gabion baskets filled with limestone were installed at intervals throughout the length of the West Tributary as part of a past effort to reduce acidity of the water. Based on SI field observations, silt deposition, and erosion (by-pass channels) have reduced or eliminated the effectiveness of the limestone baskets.

The Northeast Drainage includes a small intermittent stream, two shallow water ponds (PD 1013 and PD 1022), and a weir (Weir 1014) (Figure 4). The Northeast Drainage discharges to Sugar Creek approximately 1,800 feet east of Highway 12.

The two small streams flowing west of the West Tributary are identified in this report as the Far-West Tributaries (Figure 4). Both streams appear to be lower in elevation than the West Tributary and may receive groundwater discharges from the Site. One of these drainages originates near the southwest corner of the Site. Both drainages discharge to Sugar Creek upstream from the West Tributary confluence (Figure 4).

Two south drainages (Southeast and South-Central Drainages, Figure 1) do not appear to have been evaluated in past investigations of the Site. Both of these streams drain south under Bost Orchard Road, onto USFS land and subsequently to a tributary of Sugar Creek, identified as the

Palzo Tributary (IEPA, 1993). Both of the south drainages appear to be primarily fed by groundwater discharges from mined areas of the Site, originating as seeps.

The Palzo Tributary was not evaluated as part of the SI. It flows northward approximately parallel to the east Site boundary and discharges to Sugar Creek approximately ½ stream mile from the Site.

3.3.2 SI Sampling and Results

Sugar Creek

AMD from the Site has a notable negative impact on water quality in Sugar Creek. The IEPA identified the Site as the most significant contributor of AMD to Sugar Creek and the South Fork (IEPA, 1993). Field parameters were measured at 8 locations in Sugar Creek, including one upgradient background location (Table 4). Based on field-measured pH, iron, and manganese results, 5 samples were selected for laboratory analyses (Table 5).

The background sample (SC 1023) had a pH of 6.66 and low concentrations of iron and manganese. Net alkalinity in this sample was positive and aluminum, iron, manganese, and sulfate concentrations were generally low (Table 5). Subsequent down-gradient samples revealed generally decreasing pH values, decreasing net alkalinity, and increasing metals concentrations. The lowest pH in Sugar Creek (4.74) was measured at the bridge where the Creek exits the Site (SC-1025) (Figure 4).

West Tributary Water Quality

Six locations were field screened on the West Tributary (Figure 4) and three samples were selected for laboratory analyses. The sampling progressed in a downstream direction from the southern end of the tributary to where it discharges to Sugar Creek.

Field pHs ranged from 2.58 to 3.18, with no noticeable pattern of increasing or decreasing values. This probably indicates AMD inputs to the West Tributary occur along its entire length. The three samples submitted for laboratory analyses (WT-1003, WT-1004 and WT-1006) all exhibit characteristics of AMD: negative net alkalinity, very low pH, and elevated metals concentrations (Table 5).

Far West Tributaries

Two small streams flow into Sugar Creek west of the West Tributary confluence (Figure 4). Both streams exhibit low pH (2.68 and 3.37), and laboratory results of a sample (WT 1009) indicated AMD conditions are present (Table 6). The land west of the Far West Tributaries was not mined; therefore, an AMD source is not present in that direction. Based on the SI field observations and laboratory results, both of these streams may receive groundwater discharges from the Site.

Pond Water Quality

There are 7 ponds on the Site (Figure 4), all of which were sampled for field parameter measurements (Table 4). Four ponds were selected for sampling for laboratory analyses (Table 5). Field pH measurements ranged from 2.41 to 6.71. Four of the ponds had pH of <5. Samples from 2 of these ponds (PD-1010 and PD1002) were laboratory analyzed. The sample results showed strong AMD conditions in Pond 1010 and moderate AMD conditions in Pond 1002 (Table 6).

Samples from 2 ponds (PD-1022 and PC-1012) with pH >6 had metals concentrations that were close to background concentrations (compared to the Sugar Creek background sample).

South Drainages Water Quality

Two south-flowing drainages were observed on the south part of the Site (Figure 4). The Southeast Drainage was not flowing during the SI, but ponded water (SP 1011) was measured for field parameters (Table 4). Field parameters were measured and a sample collected from the south-central stream (SW1001), which was flowing at the time of the SI. Field pHs at both locations were very low (2.82 and 2.58, respectively). The laboratory results of sample SW1001 from the South Central Drainage indicated strong AMD conditions are present in this stream. As noted earlier, these two drainages discharge to the Palzo tributary (of Sugar Creek) at an off-site location.

3.3.3 Water Supply, Sensitive Environments and Fisheries

The 15-mile target distance limit (TDL) is shown on Figure 6. There are no municipal water supply system intakes within the 15-mile TDL. A wetland area, with a ¼ mile frontage along the South Fork, is approximately 7 stream-miles downstream from the Site (Figure 6). There are no known fisheries in Sugar Creek or the South Fork downstream of the Site; the IEPA has indicated these stream reaches are devoid of life (IEPA, 1993).

3.3.4 Flood Hazard

Flood hazard data was not readily available for the Site. However, based on the presence of floodplains along Sugar Creek, the West Tributary, and the Palzo Tributary, it can be assumed that a 100-year flood would encroach on the north, west, and east sides of the Site.

3.4 Soil Exposure Pathway

There are no human occupants on the Site and few on-Site workers (less than 10) associated with the current reclamation efforts. There is no fencing around the Site although there is a gate across the main access road. Recreational activities are allowed by the USFS but probably consist mostly of hunting. The Site is partially vegetated and is undergoing further reclamation activities, including soil augmentation and re-seeding.

Surface soils at the Site consist largely of spoil, described as clay, coal fragments, sand, sandstone, and black shale fragments (Indeco, 1998). Several studies conducted at the Site have included analyses of soil samples, typically for acidity, pH, cation exchange capacity, aluminum, phosphorus, potassium, magnesium, calcium, sodium, sulfate, and sulfide (USFS, 1980; Nawrot, 1983; Indeco, 1998). None of the studies included analyses for metals with known toxicity such as arsenic, mercury, or lead. No background soil samples were collected during the 1998 or other investigations. No soil samples were collected during the SI.

Although soils were not tested, some information about soils metals can be derived from reviewing metals concentrations in AMD in groundwater and surface water at the Site. In the groundwater sample from MW-10, detected metals included aluminum, beryllium, cadmium, calcium, copper, iron, manganese, nickel, thallium, and zinc (Table 3). In various surface water samples where AMD is indicated, the same list of metals was detected plus chromium (Table 5). Metals that were not detected in any surface water sample or the groundwater sample include antimony, arsenic, lead, mercury, selenium, and silver. Because AMD can mobilize only those metals already present in soils, rock and wastes at the Site, it can be assumed that the following trace metals may be present in these materials at the Site: beryllium, cadmium, chromium, copper, nickel, thallium, and zinc. Further evaluation of metals concentrations in the mine wastes remaining at the Site is recommended.

3.5 Air Exposure Pathway

The air exposure pathway was not directly evaluated due to the lack of soil sampling data. However, the air exposure pathway (for wind-blown dust) does not appear to be a concern because vegetation covers most of the Site. The exposed areas of the Site are undergoing reclamation that will result in additional vegetative cover.

4.0 SUMMARY AND CONCLUSION

The following are key findings of the PA/SI conducted at the Site.

- The wastes at the Site consist of mine spoil covering approximately 270 acres. Despite approximately 4 attempts at reclamation over 30 years, the Site continues to produce AMD.
- Surface water quality is significantly degraded by AMD as indicated by the low pH values and high metals concentrations in all on-site surface water samples.
- Groundwater has characteristics similar to AMD as deep as 39 feet in pyritic shale as indicated by the results in the sample from MW-11.
- Groundwater flow is inferred to be in a radial pattern; therefore, private water wells located southeast and southwest near the Site may potentially be affected by AMD-contaminated groundwater from the Site. No off-site groundwater quality data were obtained as part of this PA/SI.

- AMD-impacted groundwater discharges to surface water drainages on the west, south and north sides of the Site. All surface water draining the Site discharges to Sugar Creek.
- South Drainages (Figure 4) not previously tested are impacted by AMD. These drainages appear to be primarily groundwater fed and discharge to the Palzo Tributary of Sugar Creek.
- Two small streams that originate off-site, but discharge to Sugar Creek at the far northwest corner of the Site, are impacted by AMD. This finding suggests that AMD-impacted groundwater from the Site is discharging to these two streams.

Based on the SI results, groundwater and surface water are the two primary pathways of concern at this Site. Groundwater may flow radially from the Site, potentially reaching private wells located within ¼ mile of the Site. However, there is insufficient groundwater flow information to evaluate this concern. Groundwater affected by AMD in one sample had concentrations of beryllium, cadmium, copper, and thallium greater than the federal MCLs (no background groundwater sample was available). Groundwater also discharges to surface water at numerous seeps across the Site (no background water quality data was available).

AMD-impacted surface water is a potential threat to human health and the environment. While Sugar Creek upstream from the mined lands has a diverse ecology, the stream is devoid of life downstream from the Site and other mined lands in the area (IEPA, 1993). No surface water intake was present within the 15-mile TDL of the Site; however, there may be recreational use of this stream.

The soil pathway could not be evaluated due to the lack of soil data; however, trace metals identified in AMD indicate the presence in soils or wastes of several trace metals of possible toxicity. The air pathway similarly could not be evaluated due to the lack of soil data. However, the air pathway is probably of minor concern due to the vegetation cover that is either present or in process of being restored at the Site.

A Potential Hazardous Waste Site Preliminary Assessment Form is included in Appendix E.

5.0 PRELIMINARY BIOLOGICAL SURVEY

5.1 Introduction

A preliminary biological survey was performed by TN&A to characterize the habitat of the Site; to identify any Federal threatened and endangered (T & E) species, Illinois State listed threatened and endangered species (ST & SE) or Regional Forester sensitive species (RFSS) present; to provide recommendations for future biological studies that may be necessary prior to any project implementation; and to assess habitat in terms of the potential to sustain these species if no damage from AMD was present. An additional purpose of this survey was to investigate the potential for adverse effects that keep future restoration or remediation projects may have on the identified sensitive species. Species lists are provided in Appendix F.

5.2 Surface Water Quality

5.2.1 Data Interpretation Guidelines

Following are some general guidelines for interpreting water quality data for biological suitability:

pH

The pH of water is important as it determines the solubility and availability or amount of various nutrients and metals that can be utilized by aquatic life. Values lower than 5 - 6 pH are considered directly toxic to fish and other aquatic life, while a pH level of range of 6.5 – 8.5 is needed to sustain healthy fish populations (U.S.EPA, 1987).

Dissolved Oxygen

DO refers to the volume of oxygen contained in the water. The amount of oxygen that can be held by the water depends on water temperature, salinity, and atmospheric pressure. The lowest acceptable DO level for warm water fish is 5.0 mg/L while the lowest acceptable DO level for cold water fish is 6.0 mg/L (North Carolina State University (NCSU), 2002).

Temperature

Temperature is also very important for aquatic life, because most aquatic organisms are cold-blooded and unable to internally regulate their body temperatures. Different organisms have different temperature preferences, but generally cool water fish, such as trout, prefer temperatures ranging from 12 - 18°C, while warmer water fish, such as bass, prefer temperatures of 21 - 27°C (NCSU, 2002).

Electrical Conductivity

Electrical conductivity indicates the total amount of dissolved solids (salts and ions) in the water as well as the ability of water to carry an electric current. Generally, a healthy stream or water body would have conductivity less than 500 µS/cm. Values that are significantly higher usually signify that a water body is heavily impacted by influx of salt, nutrients, and pollutants.

5.2.2 Western Tributaries

Despite an attempt to mitigate AMD (by installation of limestone gabions), the West Tributary remains inhospitable to fish, macroinvertebrates, and aquatic vegetation due to its poor water quality. November, 2001 pH levels in this tributary ranged from 3.18 (WT-1) to 2.58 (WT 1008) (Table 4). DO readings were generally life supporting, ranging from 10.6 mg/L to 14 mg/L, largely due to the good flow of this tributary.

Two additional small tributaries (Far West Drainages) enter Sugar Creek at the extreme northwest corner of the Site, with the majority of their lengths passing through private land to the west. These tributaries appear to be largely fed by tainted groundwater from the Site. The pH of

these tributaries was 2.68 and 3.37 at sampling points WT1009 and T1024, respectively (Table 4). DO levels of 6.7 mg/L and 7.8 mg/L are within acceptable ranges, but fairly low due to low flow at the sampling points. The temperatures of the tributaries were both approximately 15 °C, which are indicative of cold-water habitat conditions. Conductivity levels were 3,100 µS/cm for WT1009 and 670 µS/cm for T1024. The conductivity level for the tributary nearest to the Site was especially high, which is an indication of the large quantity of dissolved metals entering this stream from the AMD.

5.2.3 Pond Areas

The Northeast Drainage area of the Site includes a small intermittent stream, two shallow water ponds (PD 1013 and PD 1022), and a weir (Weir 1014) (Figure 3). The drainage discharges to Sugar Creek approximately 1,800 feet east of Highway 12. The stream was not flowing during the biological survey, but was flowing during the November, 2001 SI. Both ponds were found to be completely lacking significant plant or animal life during the October, 2001 biological survey. The pH levels recorded during the SI were 4.94 in PD 1013 and 6.56 in PD 1022. Conductivity levels, temperature, and DO were all within healthy ranges in these ponds, so lack of life may be due to periodic influxes of AMD. Flowing water at the weir had a pH of 3.2 and a conductivity reading of 1,400 µS/cm, which are both indicators that the weir is more heavily impacted by groundwater AMD than its upstream ponds.

Pond 1012, which is south of the Northeast Drainage, had good readings for all water quality parameters (pH 6.38, temperature 8.6 °C, DO 15.2 mg/L, and conductivity 370 µS/cm). Analytical results indicate this pond is not impacted by AMD (Table 5). This pond should be capable of supporting aquatic life.

Pond PD 1021, which is located west of Pond 1012, also appeared to have fairly good water quality (pH 6.71, temperature 10.21°C, DO 13.8 mg/L, and conductivity 110 µS/cm). One frog (species unknown) was found here by TN&A during the October field visit.

Ponds 1002, 1007, and 1010 had good DO and temperature readings (Table 4), but all were extremely acidic (field pH measurements of 3.4, 2.61, and 2.41, respectively). Laboratory results of sample PD 1002 indicated relatively high metals concentrations indicating the presence of AMD. Pond 1010 had the lowest pH, high conductance, and high metals concentrations, indicating this pond is heavily impacted by AMD originating from groundwater.

5.2.4 Sugar Creek

The pH was significantly higher in Sugar Creek than in the West Tributary. The pH levels ranged from 6.66 at the western-most sample point (SC 1023) to 4.74 at the eastern-most sample point (SC 1025). Sample point SC 1023, a background sample location, was just upstream from the confluence of the West Tributary and Sugar Creek. A sample from the confluence itself (SC 1020) had a pH of 5.18, which was the lowest recorded pH of all Sugar Creek sampling points. Conductivity, DO, and temperature data were all within normal ranges at all sampling points in Sugar Creek. A 1993 survey of the Saline River Basin by the IEPA indicated that, while the water quality of Sugar Creek near the Site was extremely poor, the water quality upstream from the area, along with the Little Saline River, had the best stream quality overall (IEPA, 1996). An Environmental Assessment of the Site in 2001 stated that approximately 30 miles of Sugar Creek and the Saline River were non-supportive of biotic life due largely to AMD from the Palzo Mine area (IDNR, 2001).

5.2.5 South Drainages

Two South Drainages are found in the southern part of the Site and appear to be fed by groundwater. Sample SP 1011 (a seep feeding the Southeast Drainage) had a low pH (2.82), low DO (4.3 µg/L), and high conductivity (2,500 µS/cm), which indicates AMD characteristics in the groundwater of the Site. The South-Central Drainage flows south to the Palzo Tributary that discharges to Sugar Creek east of the Site. The water of this tributary was very acidic (a pH of 2.58) and high conductivity (2,700 µS/cm). Temperature and DO levels were within normal ranges.

5.3 Soil Quality

Soil quality has been characterized during several previous studies. The relevance of these data to potential ecological receptors is reviewed in this section.

Soil samples were collected by the USFS in 1980 on bare areas of the Site that had been previously cleared and treated with sludge. An average soil pH level of 3.7 and a mean calcium level of 1,318 parts per million (ppm) were recorded (Nawrot, 1983). Soil samples collected in 1982 by the SIU Cooperative Wildlife Research Laboratory on untreated, re-vegetated areas of the Site found an average soil pH level of 3.0 and a mean calcium level of 996 ppm (Nawrot, 1983). Indeco collected three soil samples from well-installation borings (in spoil) during the 1998 Site investigation (Indeco, 1998). Soil pH values ranged from 2.66 to 6.51, with an average

pH of 3.71. These previous investigations indicate disturbed areas of the site have generally acidic soils.

Levels of acidity and calcium are important in determining which plants can inhabit an area. High calcium levels are associated with the ability of vegetation to ward off stresses such as temperature changes and insect defoliation. Calcium decreases with increased acidity and leads to decreased plant vigor. In acid soils, most plants need at least 1,800 ppm of calcium to grow effectively (Western Labs, 2002). As discussed above, surficial and shallow soils at the Site are generally acidic and may have insufficient calcium levels to buffer the effects of this acidity on plants.

5.4 Vegetation

An inventory of the dominant vegetation on Site was completed by TN&A on October 16, 2001. The inventory is provided in Appendix F as Table F-1. The different plant communities of the Site are shown on Figure 7. TN&A conducted the plant survey on a controlled intuitive or meander basis. The project area was crisscrossed, making a good faith effort to search all potential community types and habitats. The central region of the Site is currently under construction and was not included in the survey. The following sections provide descriptions of the various plant communities found on the Site.

5.4.1 Floodplain Forest

The riparian plant community associated with Sugar Creek is a floodplain forest (approx. 7% of site). Vegetation consists of mature hardwoods with an understory of shrubs and saplings, and an herbaceous layer of grasses, sedges, and forbs. The canopy is dominated by sugar maple (*Acer saccharum*), silver maple (*Acer saccharinum*), and red oak (*Quercus rubra)*, but also includes pawpaw (*Asimina triloba),* shagbark hickory *(Carya ovata),* white ash *(Fraxinus americana),* sassafras *(Sassafras albidum),* sweetgum *(Liquidambar styraciflua),* tuliptree *(Liriodendron tulipifera),* American hornbeam *(Carpinus caroliniana),* and several other oak species. The understory is comprised primarily of currant *(Ribes* sp.*),* northern hackberry *(Celtis occidentalis),* alternate-leaf dogwood *(Cornus alternifolia),* Japanese honeysuckle *(Lonicera japonica)* and catbrier *(Smilax glauca).* Species such as baneberry *(Actea* sp.*),* wild oats *(Chasmanthium latifolium),* and pinkweed (*Polygonum lapthifolium*) were found in the herb layer. Slopes along Sugar Creek range from very steep and rocky at 1,000 to 2,500 feet west of County Highway 12 to very gentle immediately west of County Highway 12 (northeast corner of Site).

5.4.2 Grasslands

A large part of the northern one-third of the Site and the southern border consists of open grasslands (approx. 33% of site) of low biological diversity. Chinese lespedeza (*Lespedeza cuneata*) dominates the flora, with a few other species such as switchgrass (*Panicum sp.*) and goldenrod (*Solidago sp.*) inhabiting the moderate slopes leading down to the pond areas and Northeast Drainage. A few cottonwood (*Populus deltoides*) and sycamore (*Platanus occidentalis*) trees are scattered along the ponds near the shoreline. The littoral zone is devoid of any emergent, submergent, or floating aquatic vegetation.

5.4.3 Mixed Forest

Two areas, one along the southern boundary and the other upland of Sugar Creek, consist of a mixed forest community (approx. 7% of site). The canopy is dominated by white pine (*Pinus strobus*), red oak *(Quercus rubra*), sassafras (*Sassafras albidum*), and shagbark hickory *(Carya ovata).* Immature red cedar *(Juniperus virginiana)* dominates the shrub layer, and bluestem (*Andropogon* sp.) is dominant in the herb layer.

5.4.4 Dry Mixed Forest

The southwest corner of this Site is a dry, mixed conifer forest (approx. 10% of site), consisting primarily of loblolly pines (*Pinus taeda*), white pine (*Pinus strobus*), sumac (*Rhus* sp.), and various oak (*Quercus* sp.) and river birch (*Betula nigra*) saplings with grasses making up most of the herb layer.

5.4.5 Test Plot Area and Mixed Communities

Following acquisition of the Site in 1966, the USFS initiated various reclamation test plots using a variety of different soil amendments and plantings. This test plot area (approx. 21% of site) is located directly east of the West Tributary. The test plot and adjoining area are presently dominated by a variety of grasses such as broom sedge (*Andropogon virginicus*), orchard grass (*Dactylus glomerata*), and tall fescue (*Festuca arundinacea*); wildflowers; and other herbaceous plants such as goldenrod (*Solidago* sp.), white snakeroot (*Eupatorium rugosum*), Queen Anne's lace (*Daucus carota*), *rubus* sp., and pokeweed (*Phytolacca americana*). There are also clumps of planted trees such as river birch (*Betula nigra*), white ash (*Fraxinus americana*), silver maple (*Acer saccharinum*), black locust (*Robinia pseudoacacia*), and various pine (*Pinus* sp.) species.

5.4.6 Hardwood Forest

This narrow strip of hardwood forest (approx. 2% of site) is located directly west of County Highway 12 on the eastern edge of the Site. The forest is dominated by common greenbriar (*Smilax rotundifolia*), oak species (*Quercus* sp.), sweetgum (*Liquidambar styraciflua*), sumac (*Rhus sp.*), tuliptree (*Liriodendron tulipifera*), prickly ash (*Zanthoxylum americanum*), willow (*Salix* sp.), silky dogwood (*Cornus amomum*), and autumn olive (*Elaeagnus umbellata*).

5.5 Wildlife

An inventory of the wildlife of the Site was conducted on October 16, 2001 by TN&A. The wildlife survey was conducted concurrently with the vegetation survey. The study area was crisscrossed, making a good faith effort to search all potential community types and habitats.

5.5.1 Aquatic Wildlife

Field surveys and stream sampling of Sugar Creek, the West Tributary, the Southeast Drainage, and inland ponds found almost all areas to be nearly devoid of any aquatic vegetation, mollusks, fish, or invertebrates. The IDNR observed one blue gill *(Lepomis macrochirus)* and one cricket frog (*Acris crepitans*) on September 1, 2001 during their survey of Sugar Creek north of the Site (IDNR, 2001). The IDNR survey was conducted after a heavy rain event, so it is possible that the observed wildlife was washed down from further upstream. In a 1983 survey of the Saline River Basin conducted by the IEPA, no biotic life was found in or along Sugar Creek near the Palzo sampling Site, other than fly (*Chironomus sp.*) and microinvertebrate (*Stictochironomus sp.*) species (IEPA, 1996). The IDNR Office of Mines and Minerals also found no life in Sugar Creek when conducting research for their 2000 Environmental Assessment of the Palzo Surface Mine Reclamation Project. Furthermore, the local natural heritage biologist and fisheries stream specialist for the IDNR local office in Marion have never observed any aquatic life in this stretch of Sugar Creek (Ballard and Hirst, pers. comm., 2002). However, they have seen sensitive species such as the least brook lamprey and Indiana crayfish further upstream from the Site.

Though currently inhospitable to most aquatic organisms, several of the freshwater habitats of the Site have the potential to support a diverse array of fish, crustacean, mollusk, and invertebrate species given water quality data previously presented in Section 5.2, Specifically, several of the interior freshwater ponds (PD 1021, PD 1022, and PD 1012) that are predominantly fed by rainwater and contain fairly good water quality have some potential to support various frog and invertebrate populations. It is possible that aquatic wildlife exists but has not been observed.

5.5.2 Terrestrial/Avian Wildlife

The only wildlife observed by TN&A on the October 16, 2001 survey date was a pileated woodpecker (*Dryocopus pileatus*) and unknown frog species near Sugar Creek. Several deer tracks were also observed in the area. Other surveys of fauna on the Site have identified a variety of avian species including songbirds, Canada goose (*Branta canadensis*), great blue heron *(Ardea herodius)*, great egret (*Ardea albus*), great crested flycatcher (*Myiarchus crinitus*), turkey vulture, and American crow (*Corvus brachyrhyncos*). Other species known to utilize the Site are white-tailed deer (*Odocoileus virginianus*), eastern cottontail (*Sylvilagus floridanus*), cricket frog *(Acris crepitans)*, Cope's treefrog (*Hyla chrysolepis)*, and eastern box turtle (*Terrapene carolina*) (IDNR, 2001).

The floodplain forest has the greatest potential to support a variety of species given the presence of water, mast producing trees, and fruit-bearing shrubs. Although not yet identified on the Site, species expected to utilize the area include raccoon, opossum, skunk, gray squirrel, other common small mammals and rodents, and forest-dwelling hawks and owls. Exfoliating trees in the floodplain forest could also provide roosting habitat for a variety of bat species. Grassland habitat could support species such as mice, voles, other rodents and seed-eating birds, grass nesting birds, and raptors that feed in grasslands. The mixed forest communities could potentially provide habitat for small mammals and birds that prefer mixed forest types.

5.6 Federal Listed, State Listed, and Regional Forester Sensitive Species

The U.S. Fish & Wildlife Service has provided a list of federally listed T & E species that may potentially be within the project area. In addition, the Shawnee National Forest provided a list of RFSS and Illinois ST & SE. The federal, state, and regional species lists were reviewed to identify those species that could potentially be affected by implementation of future reclamation projects (Appendix F, Tables F-2 and F-3). The following information was collected to support decisions of which species should be excluded from future study at the Site: species presence/absence data collected by TN&A, species presence/absence data from past field surveys including the Illinois Natural Heritage Database (INHD); species historical occurrences and collection data from the Illinois Natural History Survey (INHS); publications and websites discussing habitat requirements for the species; characterization of natural communities and habitats by TN&A; all available water quality data; and knowledge of local experts, USFS biologists, and IDNR personnel.

There is a general lack of distribution and natural history information for many of these sensitive species nationwide, and many are extremely rare, which makes finding them difficult. Imperiled species are frequently found in areas where they were previously not known to exist. There have been no intensive surveys completed specifically looking for these rare, sensitive species at the Site. A field investigation conducted by TN&A on October 16, 2001 did not confirm the presence of any listed sensitive plant or wildlife species. However, it is important to note that most sensitive plant species have stopped flowering by October and have begun to senesce, making them difficult to locate in October. Furthermore, given the seasonal patterns of many wildlife species, especially migratory birds, many species of wildlife would also be unlikely to inhabit the Site in October. Past wildlife surveys by the IDNR on May 21 and June 22 of 1999 found no sensitive terrestrial or aquatic species at two areas of the Site (western edge and northeast corner). In addition, past surveys of the aquatic environment by the IDNR and IEPA previously mentioned in Section 5.5.1 found a virtual lack of all aquatic organisms and no sensitive species at the Site (IDNR, 2001; IEPA, 1996).

5.6.1 Reasons for Species Exclusion from Further Study

It is highly improbable that T & E, ST & SE, and RFSS would occur on the Site at the present time because of the high level of disturbance (by past mining operations and reclamation activities), lack of proper growing conditions for many plants, and extremely degraded water quality for aquatic dependent organisms. All plants and wildlife that cannot find suitable habitat at the Site can be excluded from further study and surveying efforts prior to project implementation. For example, plants that require calcium rich soil would probably not be found at the Site due to the acidity of the soils. Although habitat conditions exist at present for many plant species, the seed bank and soils of the mined area have experienced profound disturbance in the past. Thus, it is unlikely that plants not identified in the local area would be found on the Site because they would need to enter as seed from adjacent areas or be introduced by wildlife. Furthermore, even though the Site technically contains riparian, pond, and seep areas that could provide habitat for many sensitive wildlife species, a finding of "no suitable habitat" was designated for all species (aquatic and terrestrial) that would largely depend on the Site aquatic environments for survival. This finding was based on poor water quality found in many areas of the Site.

There are several other reasons why species were excluded from further analysis. Many of the listed species are at the edge of their biological range in southern Illinois and are probably already stressed by less than optimal habitat conditions. Some of these species may occur in more pristine areas of the Shawnee National Forest, but are probably not going to survive in the degraded areas of the Site. Other species, although technically within their range in southern Illinois, are not known to occur in Illinois or the Ohio River watershed in recent times. Therefore, it is very unlikely that they would be found at the Site. Species that could technically find habitat in the Site area, but are not found in nearby areas of higher quality are also extremely unlikely to be found at this Site. All of these species can also be excluded from future study prior to future project implementation.

5.6.2 Species for Further Study Prior to Project Implementation

Due to the lack of biological surveying of this area in the past, all plant and wildlife species that technically could find suitable habitat in the Site were deemed worthy of future study and survey efforts prior to any project implementation.

Flora Species

Although there have been no sensitive plant populations located at the Site by TN&A or other parties, suitable habitat does exist for several plant species of concern. It is possible, although not probable, that such species exist on the Site but have not been detected due to scarcity and incorrectly timed surveys. Scheduling several plant surveys to cover different flowering events throughout spring and summer and different habitat areas of the Site should be adequate to determine presence/absence of these plant species more conclusively.

Fauna Species

There is also guarded optimism that the Site contains habitat in its present condition for some sensitive species of reptiles, amphibians, birds, and mammals and one species of insect and crustacean. Many of these wildlife species may not use the Site for breeding or as their sole range, but may migrate through or feed in the area at various times during the year. Efforts should be made to actively survey for these wildlife species taking into consideration their habitat preferences and seasonal patterns and designing projects considering their needs. Table F-4 contains more detailed information regarding seasonal patterns of wildlife species possibly inhabiting the Site, as well as recommended time frames and locations for future biological surveying efforts. Future survey efforts should concentrate on the less impacted, higher quality habitats of the Site including the floodplain forest and the ponds with good water quality (PD 1012, PD 1021, and PD 1022).

5.6.3 Species with Potential to Inhabit the Area in the Future

Although the Site does not offer quality habitat at present for most species of concern, there is potential that the Site could provide more optimal conditions for sensitive plants and be much better utilized by wildlife in the future if AMD is controlled and habitat restoration projects are implemented. Re-colonization of the Site by plants and wildlife also depends on the presence of nearby populations that could supply recruits to the area. All species that have some potential to inhabit this area in the future (Tables F-2 and F-3) should be considered when designing future projects to ensure that habitat for wildlife is improved or retained and not destroyed.

Flora Species

Although no sensitive flora species have been found at the Site by TN&A or other local experts, the INHD, INHS, and staff of the Shawnee National Forest have identified many sensitive species within Williamson and adjacent counties. Therefore, some potential exists for these plants to re-colonize the Site from adjoining areas after reclamation and restoration projects have improved growing conditions. Plants such as the small whorled pogonia (*Isotria medeoloides*), large whorled pogonia (*Isotria verticillata*), and small green woodland orchid (*Platanthera clavellata*) thrive in acidic conditions and could potentially become established at the Site. See Table F-2 for a description of which plants have the best potential to inhabit this area without (or with less) AMD.

Fauna Species

Though currently inhospitable to most aquatic organisms, several of the freshwater habitats of the Site have potential to support a diverse array of fish, crustacean, mollusk, and invertebrate species if AMD can be remediated. The West Tributary and Sugar Creek have good DO and temperature levels, but will not be hospitable to wildlife until the acidity (pH) and mineral inputs are controlled. Unfortunately, in order to remediate the AMD, many of the aquatic habitats may

have to be altered significantly (elimination of substrate, etc.) and this will affect the ability of aquatic organisms to inhabit the Site area in the future.

There is good potential for several sensitive aquatic species to re-colonize the Site in the future if AMD can be controlled (Table F-3). There are known populations of the least brook lamprey (*Lampetra aepyptera*; RFSS, ST) and the Indiana crayfish (*Oronectes indianensis*; RFSS and SE) further upstream of the Site on Sugar Creek (Ballard and Hirst, pers. comm., 2002; INHS records; INHD records). If AMD could be controlled and the water quality improved in the portion of Sugar Creek bordering the Site, a vital corridor for these species could be created to connect them to the remainder of Sugar Creek and the Saline and Ohio River drainages.

Remediating and restoring this Site will also make this area more attractive to migrating birds and mammals, especially ones that prefer a mixture of woodland and grassland habitats such as the northern harrier (*Circus cyaneas*) and Cooper's hawk (*Accipiter cooperii*), species that nest in grassland habitats including Henslow's sparrow (*Ammodramus henslowii*), or that feed along forested water bodies such as the Indiana bat (*Myotis sodalis*) and bald eagle (*Haliaeetus leucocephalus*). The federally threatened bald eagle has also been recorded for Williamson County by the INHD and has some potential to inhabit this area in the future. The river otter (*Lutra canadensis*) and yellow-crowned night heron (*Nyctanassa violacea*) could also benefit from improved water quality.

Other state-listed species such as the red-shouldered hawk (*Buteo lineatus*), golden mouse (*Ochrotomys nuttalli*), rice rat (*Oryzomys palustris*), timber rattlesnake (*Crotalus horridus*), Bewick's wren (*Thryomanes bewickii*), and the barn owl (*Tyto albo)* have also been recorded to occur in Williamson County by the INHD. These species could potentially re-colonize the Site if conditions improve.

5.7 General Biological Management Recommendations

Every effort should be made to reduce AMD to Sugar Creek, as it has the potential to provide a very important corridor for several threatened species of wildlife such as the least brook lamprey and Indiana crayfish.

Future projects to reduce infiltration and increase run-off for the purposes of reducing AMD could result in loss of habitat for amphibians and reptiles. If possible, future restoration projects should consider creation or restoration of wetland and pond habitats at the Site. If AMD can be controlled, there is a potential for amphibians and reptiles to re-colonize this area. Several species of amphibians such as Cope's gray tree frog (*Hyla chrysoscelis*) and other ranids have been observed on Site by the IDNR (Ballard pers. comm., 2002).

The lowland hardwood forest that borders Sugar Creek provides the best habitat of the entire Site due to its lack of manipulation in past mining and remediation operations. An effort should be made to save as much of this area as possible. Due to its lack of manipulation, this forest has the

best potential for harboring sensitive species of plants. This riparian forest will also serve an important role in any recovery efforts for wildlife of Sugar Creek. The trees provide food and shade for many species of aquatic life and reduce sedimentation into the water. Besides amphibians, reptiles, and fish, many other threatened species use floodplain forests as well. Gray bats (*Myotis grisescens*), southeastern myotis (*M. austoriparius*), and Indiana bats use wooded areas along streams to feed and drink. Indiana bats will also use trees with exfoliating bark (such as shagbark hickories) for roosting. Any trees that need to be removed in this forest should be cut outside of the maternity period for the Indiana bat, September 1 through April 15.

A large area of the present Site grassland area should be maintained and replanted with a mixture of native warm season grasses and wildflowers. Grasses such as big bluestem (*Andropogon gerardi*) and little bluestem (*Andropogon scoparius*) will provide good food for many insects such as the caterpillar of the state threatened cobweb skipper (*Hesperia metea*) as well as provide food for many other species of concern. Planting a variety of native wildflowers will provide pollen and nectar for adult butterflies. The short-eared owl (*Asio flammeus*), barn owl, northern harrier, Cooper's hawk, sharp-shinned hawk (*Accipiter striatus*), and Henslow's sparrow all use grassland habitat (and the insects that live there) for either feeding and/or nesting. Grassland habitat could also be important for many species of small mammals.

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Figures

WEST TRIBUTARY

FAR WEST TRIBUTARIES

SUGAR CREEK

NORTHEAST DRAINAGE

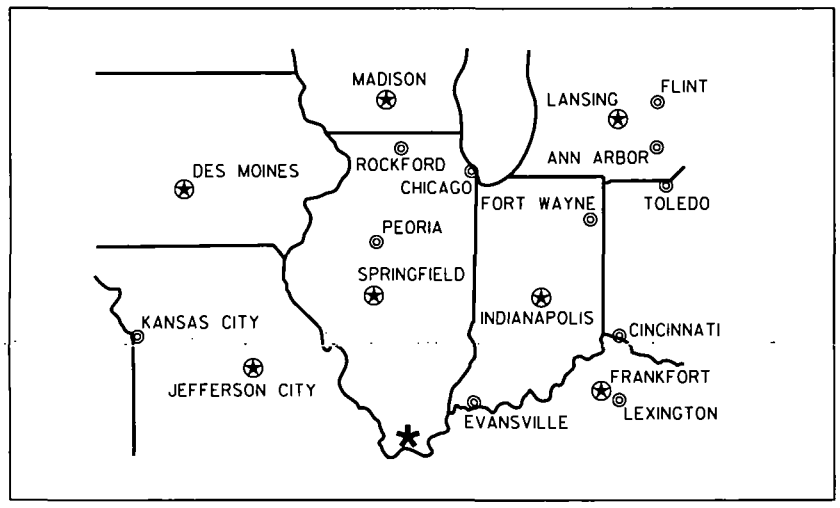
COUNTY HWY 12

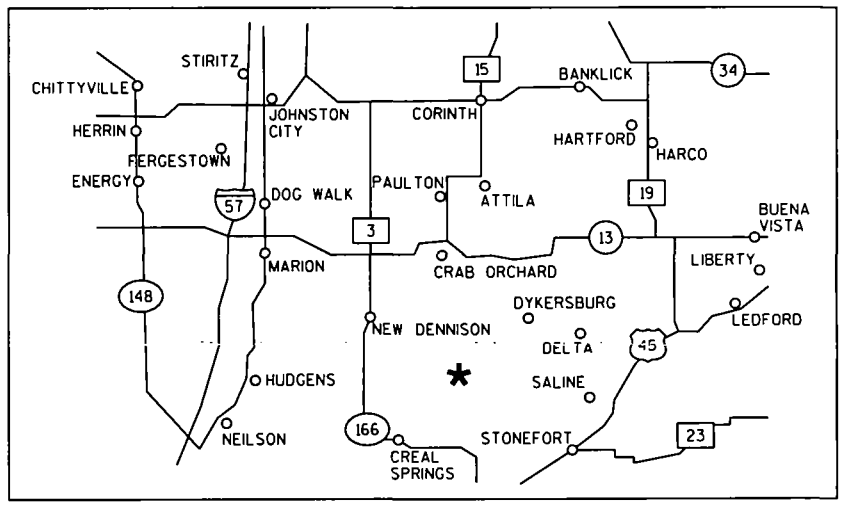
BOST + ORCHARD ROAD

SOUTH DRAINAGES

ROADS (SOME NOW ABANDONED)

WEST TRIBUTARY





★ PALZO MINE SITE

427 0 427

N

SCALE: 1" = 427'

PALZO MINE SITE SOURCE: INDECO, 1998

T N & Associates, Inc.
Engineering and Science

PALZO MINE SITE
PRELIMINARY ASSESSMENT/SITE INSPECTION
DRAFT - JANUARY 2002

FIGURE 1
STUDY AREA AND LOCATION MAP
SHAWNEE NATIONAL FOREST, ILLINOIS

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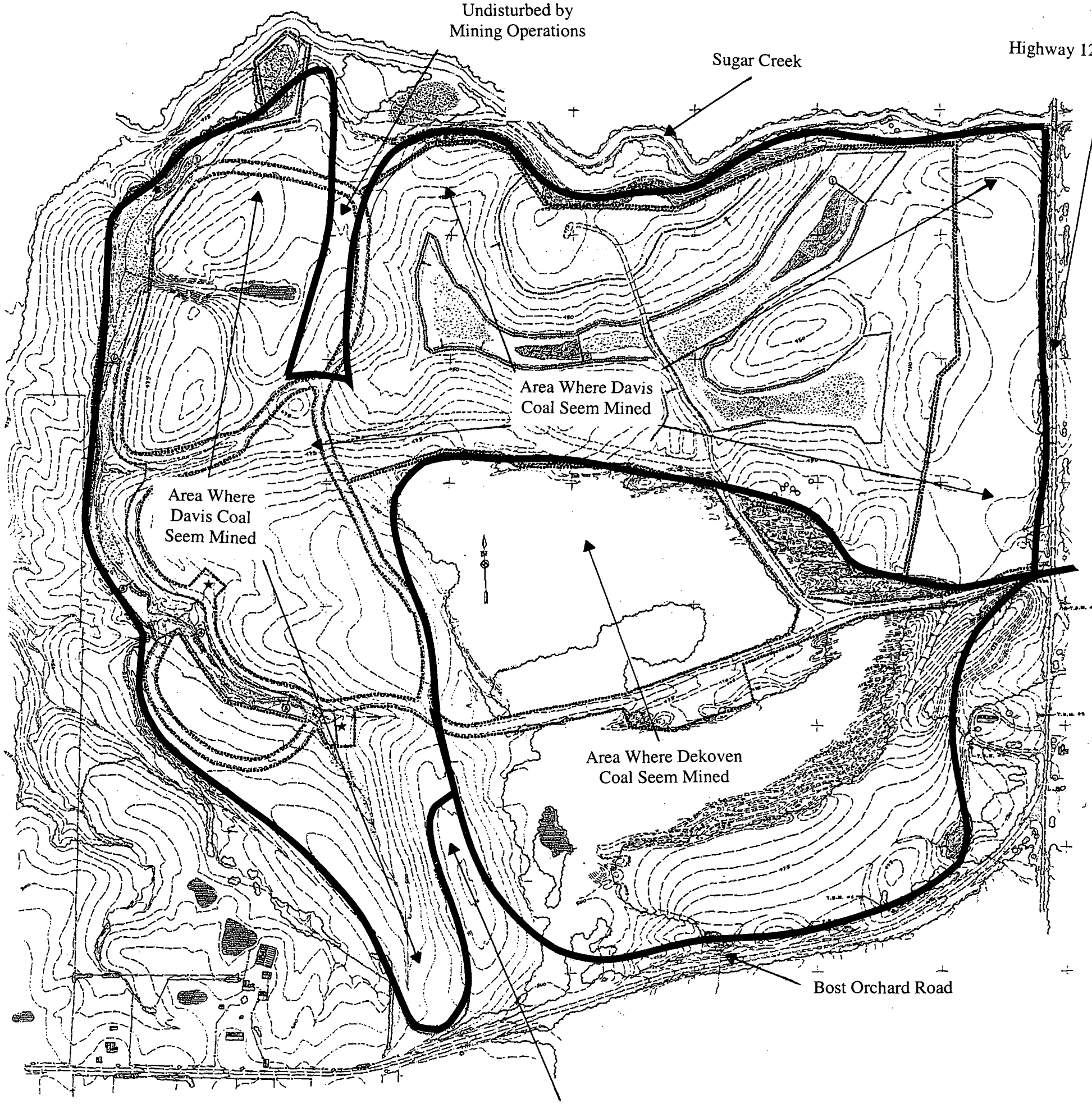

N

SCALE: 1" = 427'

427 0 427

PALZO MINE SITE SOURCE: INDECO, 1998

TN & Associates, Inc. Engineering and Science	PALZO MINE SITE PRELIMINARY ASSESSMENT/SITE INSPECTION DRAFT - JANUARY 2002	FIGURE 2 AREAS MINED SHAWNEE NATIONAL FOREST, ILLINOIS

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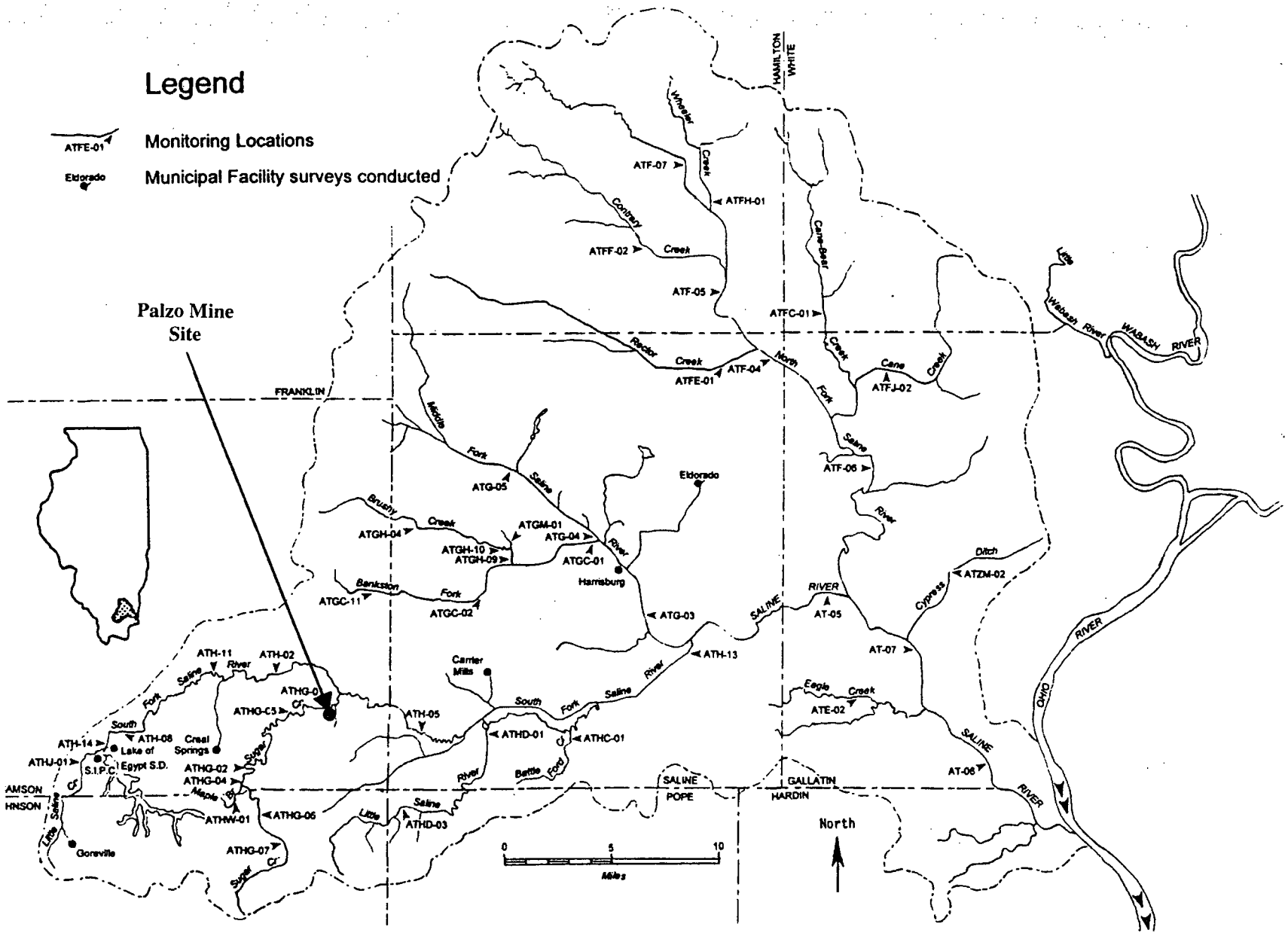
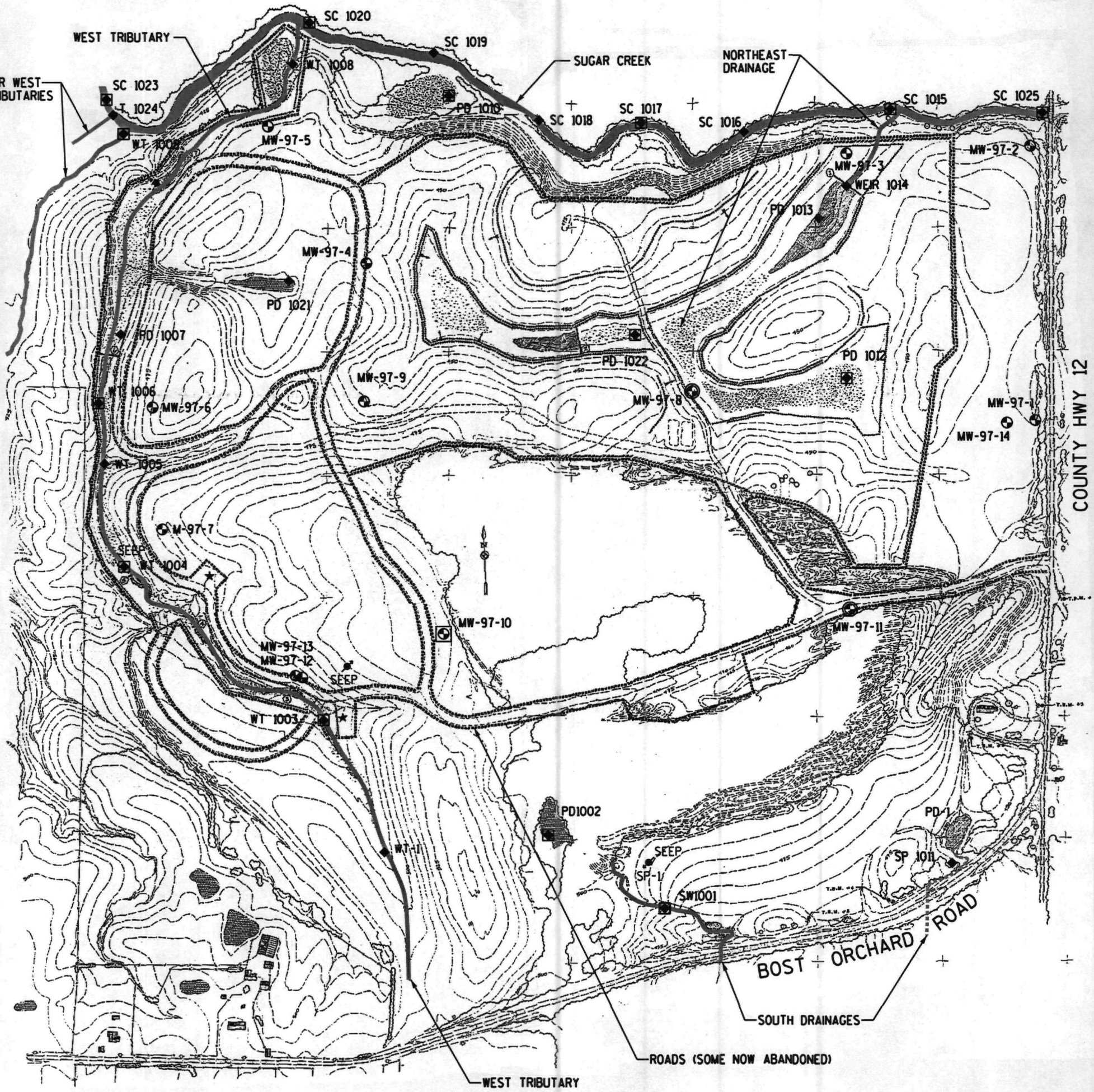


T N & Associates, Inc.
Engineering and Science

Source: IEPA Saline River Basin Intensive Survey, 1993.

Figure 3
IEPA Saline River Watershed Map

Palzo Mine Site
Shawnee National Forest
Williamson, IL



LEGEND

- SURFACE FIELD SCREEN LOCATION
- SAMPLE LOCATION
- MONITORING WELL
- MONITORING WELL FIELD SCREEN LOCATION
- SEEP LOCATION

N

SCALE: 1" = 427'

427 0 427

PALZO MINE SITE SOURCE: INDECO, 1998

TN & A T N & Associates, Inc. Engineering and Science	PALZO MINE SITE PRELIMINARY ASSESSMENT/SITE INSPECTION DRAFT - JANUARY 2002	FIGURE 4 SITE PLAN WITH SAMPLING LOCATIONS SHAWNEE NATIONAL FOREST, ILLINOIS

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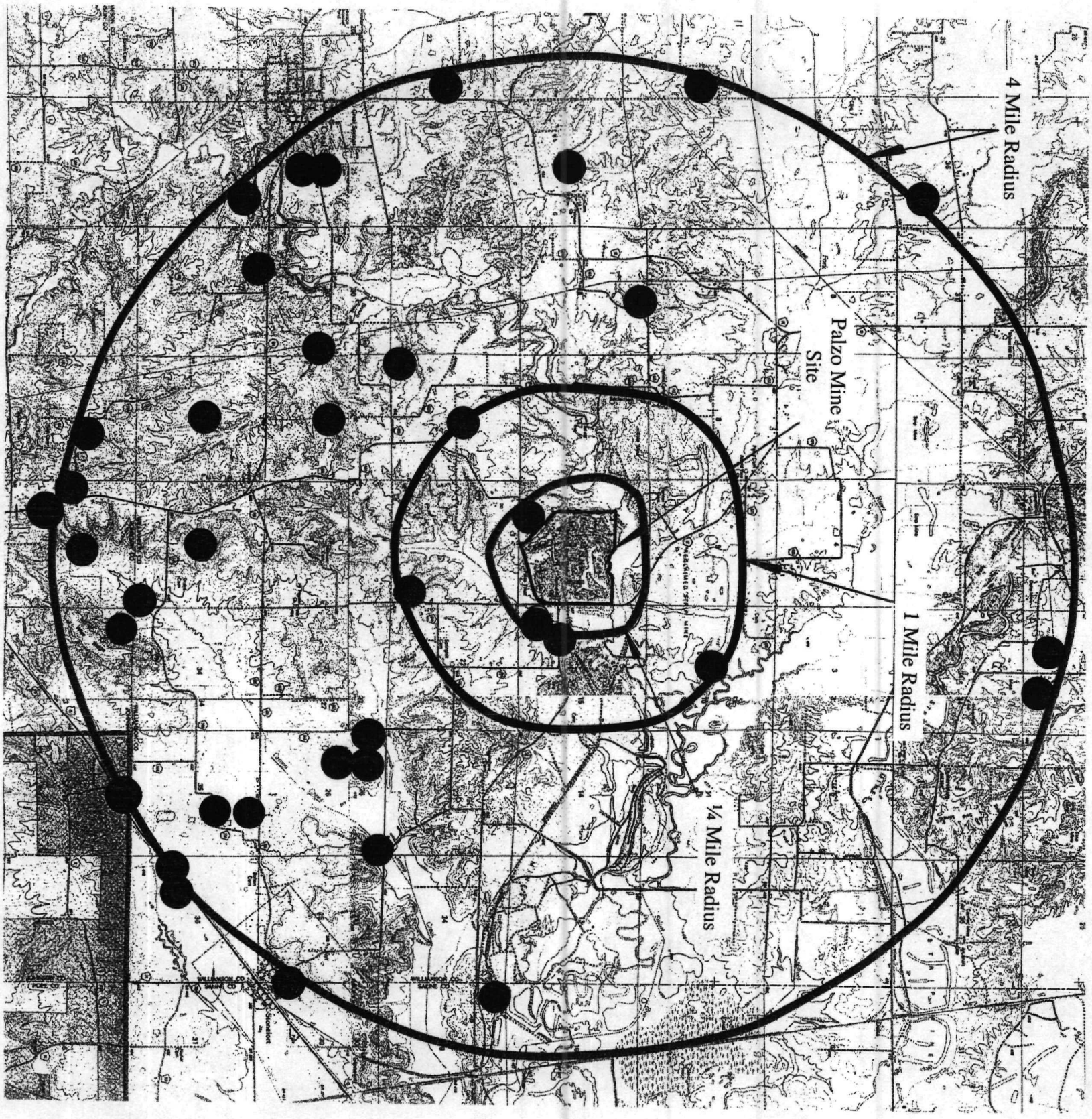

N

Legend

● = Approximate Well Locations

1 inch = 1 mile

Source: USGS QUADS, Crab Orchard, Carrier Mills, Stonefort, and Creal Springs.

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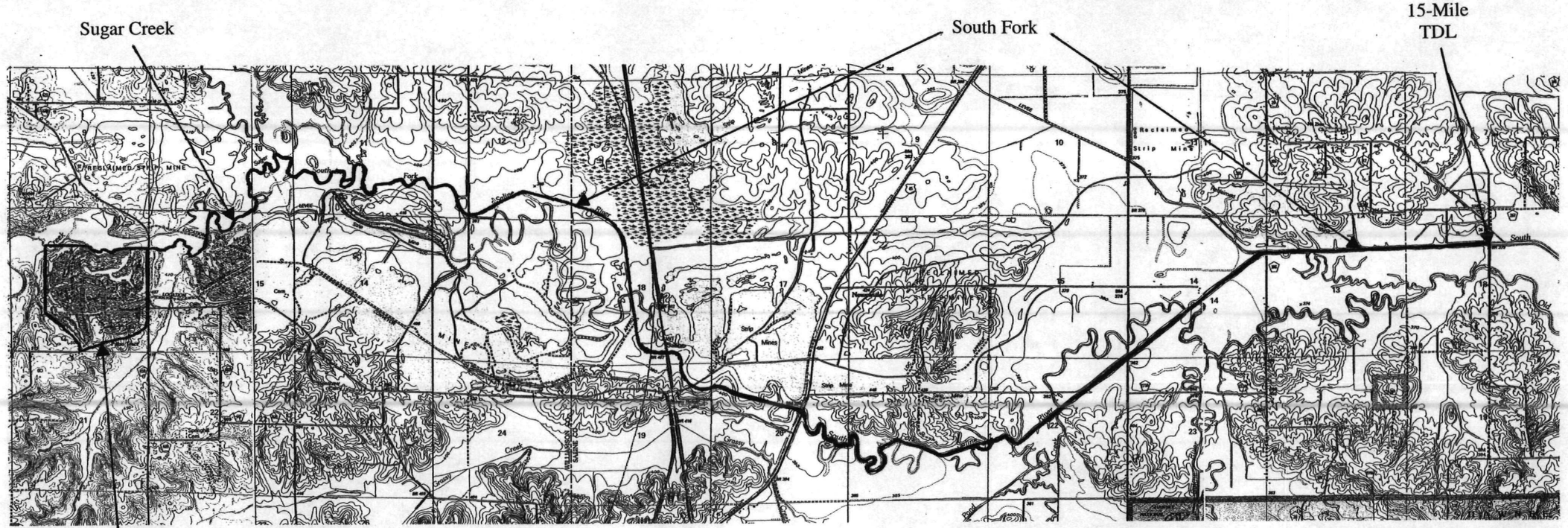
Engineering and Science

Figure 5
1-Mile and 4-Mile Radii Map

Palzo Mine Site
Shawnee National Forest
Williamson, IL



N

Scale
1.25 inches = 1 mile

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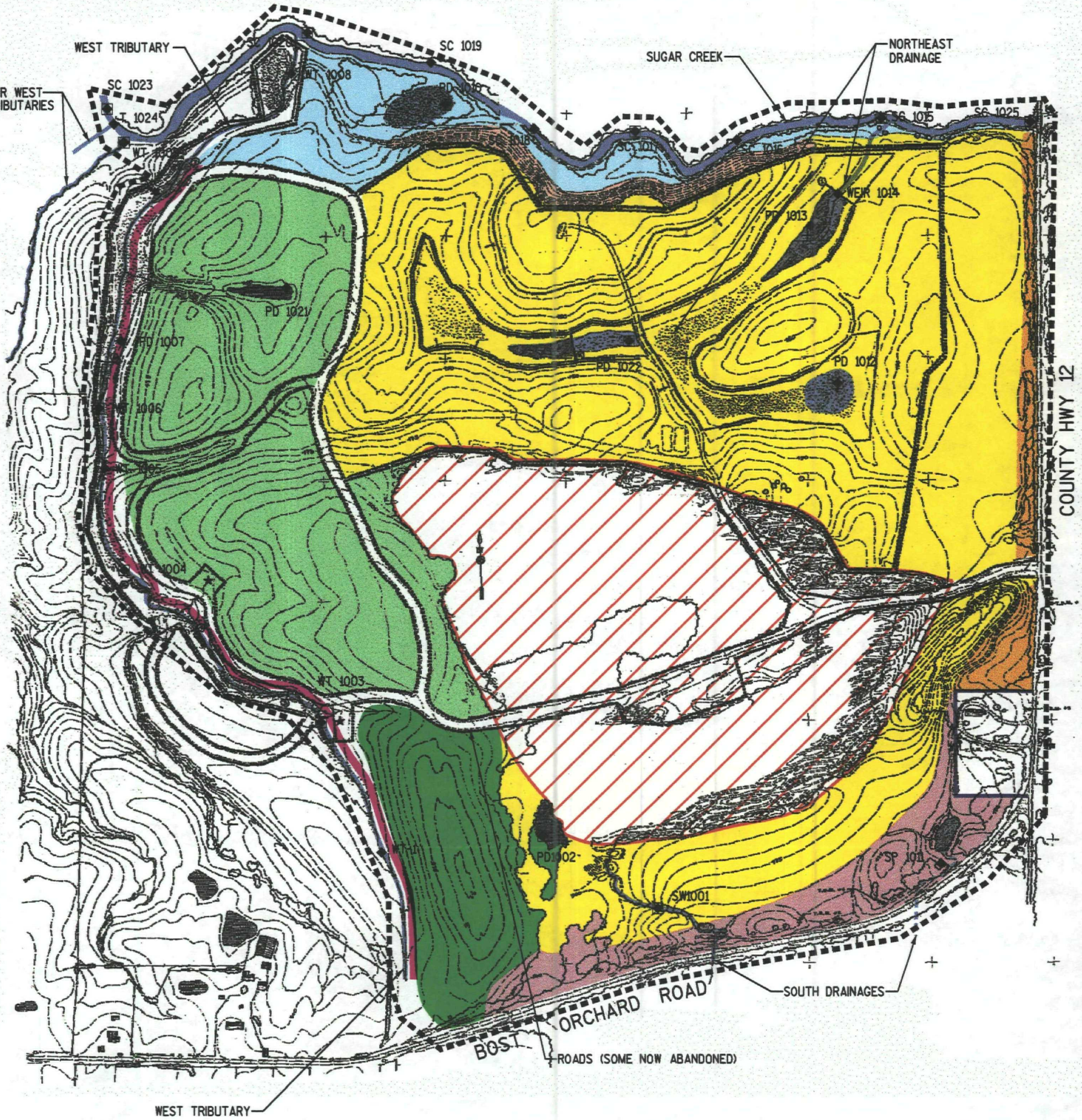
Source: USGS QUADS, Crab Orchard, Carrier Mills, Stonefort, Creal Springs.

Figure: 6
15-Mile TDL Map

Palzo Mine Site
Shawnee National Forest
Williamson, IL



N

SCALE: 1" = 427'

5' CONTOURS

427 0 427

LEGEND

- TEST PLOT AREA
- MIXED FOREST
- HARDWOOD FOREST
- DRY MIXED FOREST
- FLOODPLAIN FOREST
- GRASSLAND
- WATER
- MIXED COMMUNITIES
- CONSTRUCTION AREA
- PROJECT AREA LIMIT

PALZO MINE SITE SOURCE: INDECO, 1998

T N & Associates, Inc.
Engineering and Science

PALZO MINE SITE
PRELIMINARY ASSESSMENT/SITE INSPECTION
DRAFT - JANUARY 2002

FIGURE 7
PLANT ASSOCIATIONS
SHAWNEE NATIONAL FOREST, ILLINOIS

FILE NAME: s:\Z NaturalResources\2001Projects\2001197 Shawnee NF-Palzo Mine\palzo07.dgn 03/14/2002 02:00:23 PM

Table 1. Site Stratigraphy

Palzo Mine Site - Shawnee National Forest,IL
PA/SI Report, January 2002

System	Geologic Unit			Lithologic Description	Thickness (Approximate Depth) (ft)
Pleistocene	Grantsburg-Robbs-Wellston Soil Association			Soils derived from glacial deposit (Loess)	Thin (0 - 8 ft)
Pennsylvanian	Desmoinesian Series	Spoon Formation	Sandstone	Brown Medium Grain	Approximately 65 ft (8 - 73 ft)
			Dekoven Coal	Bituminous Coal Total Sulfur 6.13-percent (IDNR, 1999)	3.5 - 4 ft (73 - 77 ft)
			Shale	Black Pyretic Shale, Fissile, Pyretic Sulfur 3.84 - 3.98-percent (INDECO, 1998)	10 - 12 ft (77 - 87 ft)
			Davis Coal	Bituminous Coal Total Sulfur 4.83-percent (IDNR, 1999)	3.5 - 4 ft (87 - 90 ft)
			Shale	Gray to Black	Undetermined

Sources:
United States Geological Survey, 1995, Groundwater Atlas of the United States, Segment 10 Hydrologic Investigation Atlas 730-K
The American Association of Petroleum Geologist, Geological Highway Map of the Great Lakes Region, Map11
Illinois Department of Natural Resources, Office of Mines and Minerals, Division of Abandoned Mined Lands Reclamation, 1999, Palzo Surface Mine Project
INDECO, Inc., 1998, Southern Illinois Investigative Services, Palzo Mine Site; AML-GsWA-9600J, Williamson County, Illinois, Site Study and Recommendations

Table 2. Population Data

Palzo Mine Site - Shawnee National Forest, IL
PA/SI Report - January 2002

Population in Site Area	
Population Radius	**Population**
0.25 Mile[1]	4 Residences 9 Persons[2]
1 Mile[1]	27 Residences 63 Persons[2]
2 Mile[3]	234
3 Mile[3]	555
4 Mile[3]	1,275

[1] = Based on USGS Crab Orchard 7.5 Quadrangle, 1996.
[2] = Based on 2.35 persons per household (US Census, 2000).
[3] = Based on LandView IV database, 1990.

Table 3. Groundwater Results

Palzo Mine Site - Shawne National Forest, IL
PA/SI Report, January 2002

	On-Site Monitoring Wells					
Field Location :	MW-10	MW 8	MW-11			
Matrix :	Water	Water	Water			
Sample Type :	Normal					
Date Collected :	11/7/2001	11/7/2001	11/7/2001			
Time Collected :	1505	--	--			
Well Depth (ft)	24	19	39	Federal MCLs[1]	Secondary Standards[2]	Illinois Groundwater Quality Standards[4]
Screen Formation	Spoil	Spoil	Pyritic Shale			
FIELD PARAMETERS						
Fe++ (mg/L)*	50	>500	>500	NS	NS	NS
Mn (mg/L)**	5	0 - 2	0	NS	NS	NS
pH	4.38	2.9	2.45	NS	6.5-8.5	6.5 - 9.0
Conductivity (µS/cm)	2,000	4500	6700	NS	NS	NS
Turbidity (NTU)	200	330	290	NS	NS	NS
Dissolved Oxygen (mg/L)	4.5	8.3	4.3	NS	NS	NS
Temperature (°C)	17.7	19.2	17.1	NS	NS	NS
TDS (mg/L)	1.3	2.9	4.2	NS	NS	NS
ORP (mV)	265	340	363	NS	NS	NS
METALS (ug/L)				ug/L	ug/L	ug/L
Aluminum	100,000	NA	NA	NS	50 - 200	NS
Antimony	20 U	NA	NA	6	NS	6
Arsenic	20 U	NA	NA	50[3]	NS	50
Beryllium	**20**	NA	NA	4	NS	4
Cadmium	**25**	NA	NA	5	NS	5
Calcium	270,000	NA	NA	NS	NS	NS
Chromium	6 U	NA	NA	100	NS	100
Copper	24	NA	NA	1,300	1,000	650
Iron	110,000	NA	NA	NS	300	5000
Lead	10 U	NA	NA	15	NS	7.5
Manganese	34,000	NA	NA	NS	50	150
Mercury	0.2 U	NA	NA	2	NS	2
Nickel	800	NA	NA	NS	NS	100
Selenium	20 U	NA	NA	NS	NS	50
Silver	10 U	NA	NA	NS	100	50
Thallium	**23**	NA	NA	2	NS	2
Zinc	2,000	NA	NA	NS	5,000	5000
GENERAL CHEMISTRY (mg/L)						
Acidity as $CaCO_3$	640	NA	NA	NS	NS	NS
Alkalinity as $CaCO_3$	20 U	NA	NA	NS	NS	NS
Hardness	970	NA	NA	NS	NS	NS
Sulfate	1,700 J	NA	NA	NS	250,000	400,000
Sulfide	1 UJ	NA	NA	NS	NS	NS

* = Results derived from Iron Test colormetric strips.

** = Reults derived from Manganese Test Colormetric strips.

J = Analyte detected, but concentration estimated due to potential accuracy or precision bias; orconcentration reported above MDL but below establishedproject reporting limit

U = Not Detected. Parameter was not detected at a concentration equal to or greater than the reported value

mg/L = milligrams per liter °C = degrees Celcius -- = Not Determined

µS/cm = microsiemens per centimeter mV = millivolts NA = Not Analyzed

NTU = nephelometer turbidity units

[1] MCL = federal Maximum Contaminant Level - The maximum permissible level of a contaminant in waterwhich is delivered to any user of a public water system. MCLs are enforceable standards.

[2] National Secondary Drinking Water Regulations (NSDWRs or secondary standards) are non-enforceableguidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) oraesthetic effects (such as taste, odor, or color)

[3] The MCL for arsenic will change to 10 ug/L effective January 23, 2006.

[4] Illinois State Law Title 35, Part 620, D 620.410 Groundwater Quality Standards for Class I: Potable Resource Groundwater

Bold indicates concentration exceeds federal MCL

Table 4. Field Parameter Results

Palzo Mine Site - Shawnee National Forest, IL
PA/SI Report, January 2002

Location Type	Far West Drainages		Sugar Creek								Northeast Drainage	Southern Drainage	Southeast Drainage
Sampling Location	T 1024	WT 1009	SC 1023	SC 1020	SC 1019	SC 1018	SC 1017	SC 1016	SC 1015	SC 1025	Weir 1014	SW 1001	SP 1011
GPS Coordinates													
Latitude	37° 39' 17.80"	37° 39' 18.94"	37° 39' 18.65"	37° 39' 21.42"	37° 39' 20.58"	37° 39' 19.02"	37° 39' 17.08"	37° 39' 17.10"	37° 39' 18.46"	37° 39' 18.36"	37° 39' 16.81"	37° 38' 45.60"	37° 38' 45.74"
Longitude	88° 46' 37.25"	88° 46' 28.89"	88° 46' 37.26"	88° 46' 27.32"	88° 46' 25.12"	88° 46' 16.92"	88° 46' 08.77"	88° 46' 01.59"	88° 45' 55.80"	88° 45' 49.26"	88° 45' 57.47"	88° 46' 4.55"	88° 45' 58.21"
Parameters													
Fe++ (mg/L) *	10	500	0 - 3	3 - 10	3	3 - 10	3 - 10	10	10	25	25	50	250
Mn (mg/L) **	3	2	0	0 - 2	0 - 2	0 - 2	0 - 2	2	2	2	2 - 5	20 - 50	2
pH	3.37	2.68	6.66	5.18	6.07	5.92	5.9	5.51	5.28	4.74	3.21	2.58	2.82
Conductivity (µS/cm)	670	3,100	390	420	420	430	450	480	530	650	1,400	2,700	2,500
Turbitity (NTU)	3	5	14	200	22	12	16	11	24	48	3	140	5
Dissolved Oxygen (mg/L)	7.8	6.7	6.7	4	6.8	9.8	7.7	10.8	7.8	9	13.9	18.2	4.3
Temperature (°C)	15.2	15.1	13	12.4	10.7	11.1	10.5	10.4	10.2	11.7	12.7	10.4	9.4
TDS (mg/L)	0.43	2	0.25	0.28	0.27	0.28	0.29	0.21	0.34	0.42	0.9	1.8	1.6
ORP (mV)	402	442	30	114	85	97	98	144	181	247	451	481	411

Location Type	West Tributary						Surface Impoundment or Pond Sample						
Sampling Location	WT 1	WT 1003	WT 1004	WT 1005	WT 1006	WT 1008	PD 1010	PD 1007	PD 1002	PD 1013	PD 1012	PD 1022	PD 1021
GPS Coordinates													
Latitude	37° 38' 45.69"	37° 38' 54.10"	37° 38' 58.88"	37° 39' 04.45"	37° 39' 08.32"	37° 39' 17.44"	37° 39' 18.90"	37° 39' 09.84"	37° 38' 48.99"	37° 39' 11.23"	37° 39' 07.12"	37° 39' 09.32"	37° 39' 11.70"
Longitude	88° 46' 20.63"	88° 46' 18.92"	88° 46' 33.59"	88° 46' 35.41"	88° 46' 36.00"	88° 46' 35.23"	88° 46' 18.16"	88° 46' 35.21"	88° 46' 13.55"	88° 46' 3.95"	88° 45' 58.16"	88° 46' 09.42"	88° 46' 27.17"
Parameters													
Fe++ (mg/L)	3	5 - 50	100 - 250	250	25 - 50	10	50	25 - 50	3	0	0	0	0 - 3
Mn (mg/L)	2	25	50 - 100	5	50 - 100	5	100	50 - 100	5	2	0	0	0 - 2
pH	3.18	2.66	2.69	2.84	2.58	2.58	2.41	2.61	3.4	4.94	6.38	6.56	6.71
Conductivity (µS/cm)	960	3,100	3,200	2,900	3,200	2,900	4,300	3,100	560	1,210	710	370	110
Turbitity (NTU)	2	1	20	16	5	1	16	1	5	7	7	19	18
Dissolved Oxygen (mg/L)	14	10.6	13.4	11.4	10.8	11.8	13.9	12.1	13.1	15.8	15.2	13.8	13.8
Temperature (°C)	12.9	16.1	13.7	16.8	16.4	15.8	10.3	15.8	13.2	10.2	8.6	15.1	10.9
TDS (mg/L)	0.63	2	2.1	1.9	2.1	1.9	2.8	2	0.36	0.8	0.46	0.25	0.07
ORP (mV)	521	495	481	438	553	496	535	543	444	269	55	189	92

* = Results derived from Iron Test colormetric strips.
** = Reults derived from Manganese Test Colormetric strips.
mg/L = milligrams per liter
µS/cm = microsiemens per centimeter
NTU = nephelometer turbidity units
°C = degrees Celcius
mV = millivolts

Table 5. Surface Water Sample Results

Palzo Mine Site - Shawnee National Forest, IL
PA/SI Report - Draft January 25, 2002

Location Type :	Surface Impoundment or Pond Sample					Sugar Creek					Southwest Drainage	West Tributary			Far West Drainages	Equipment Rinsate
Field Location :	PD-1010	PD-1002	PD-1012	PD-1022	PD-10229 Duplicate	SC-1023 Background	SC-1020	SC-1017	SC-1015	SC-1025	SW-1001	WT-1003	WT-1004	WT-1006	WT-1009	ER-1
Date Collected :	11/6/2001	11/6/2001	11/7/2001	11/7/2001	11/7/2001	11/7/2001	11/7/2001	11/7/2001	11/7/2001	11/7/2001	11/6/2001	11/6/2001	11/6/2001	11/6/2001	11/6/2001	11/7/2001
Time Collected :	1628	1054	845	1422	1425	1235	1050	1010	940	1333	1029	1335	1414	1450	1605	1515
GPS COORDINATES																
Latitude	37° 39' 18.90"	37° 38' 48.99"	37° 39' 07.12"	37° 39' 09.32"	no data	37° 39' 18.65"	37° 39' 21.42"	37° 39' 17.08"	37° 39' 18.46"	37° 39' 18.36"	37° 38' 45.60"	37° 38' 54.10"	37° 38' 58.88"	37° 39' 08.32"	37° 39' 18.94"	not applicable
Longitude	88° 46' 18.16"	88° 46' 13.55"	88° 45' 58.16"	88° 46' 09.42"	no data	88° 46' 37.26"	88° 46' 27.32"	88° 46' 08.77"	88° 45' 55.80"	88° 45' 49.26"	88° 46' 4.55"	88° 46' 18.92"	88° 46' 33.59"	88° 46' 36.00"	88° 46' 28.89"	not applicable
FIELD PARAMETERS																
Fe++ (mg/L)*	50	3	0	0	--	0 - 3	3 - 10	3 - 10	10	25	50	5 - 50	100 - 250	25 - 50	500	--
Mn (mg/L)**	100	5	0	0	--	0	0 - 2	0 - 2	2	2	20 - 50	25	50 - 100	50 - 100	2	--
pH	2.41	3.4	6.38	6.56	--	6.66	5.18	5.9	5.28	4.74	2.58	2.66	2.69	2.58	2.68	--
Conductivity (µS/cm)	4,300	560	710	370	--	390	420	450	530	650	2,700	3,100	3,200	3,200	3,100	--
Turbidity (NTU)	16	5	7	19	--	14	200	16	24	48	140	1	20	5	5	--
Dissolved Oxygen (mg/L)	13.9	13.1	15.2	13.8	--	6.7	4	7.7	7.8	9	18.2	10.6	13.4	10.8	6.7	--
Temperature (°C)	10.3	13.2	8.6	15.1	--	13	12.4	10.5	10.2	11.7	10.4	16.1	13.7	16.4	15.1	--
TDS (mg/L)	2.8	0.36	0.46	0.25	--	0.25	0.28	0.29	0.34	0.42	1.8	2	2.1	2.1	2	--
ORP (mV)	535	444	55	189	--	30	114	98	181	247	481	495	481	553	442	--
METALS (ug/L)																
Aluminum	150,000	15,000	200 U	200 U	200 U	200 U	5,400	3,000	6,600	15,000	130,000	160,000	170,000	170,000	170,000	200 U
Antimony	20 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	20 U	20 U	20 U	20 U	10 U
Arsenic	20 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	20 U	20 U	20 U	22	10 U
Beryllium	22	6.6	1 U	1 U	1 U	1 U	1.2	1 U	1.6	3	15	21	26	25	27	1 U
Cadmium	28	14	1 U	1 U	1 U	1 U	2.7	2.4	3.7	6.3	43	160	130	120	86	1 U
Calcium	200000	33000	140000	71000	70000	39000	42000	43000	54000	58000	180000	170000	160000	140000	160000	100 U
Chromium	45	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	5.2	62	160	83	78	57	3 U
Copper	110	11	10 U	10 U	10 U	10 U	10 U	10	10 U	10 U	250	450	290	260	95	10 U
Iron	300,000	4,700	250	380	300	2,000	5,400	6,100	14,000	27,000	120,000	120,000	280,000	200,000	190,000	100 U
Lead	10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	10 U	10 U	10 U	5 U
Manganese	62,000	5,500	84	16	11	870	1,400	1,800	2,900	3,500	4,800	8,900	16,000	13,000	13,000	2 U
Mercury	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	1,200	140	5 U	5 U	5 U	6.2	38	44	71	110	600	890	1,100	1,000	910	5 U
Selenium	20 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	20 U	20 U	20 U	20 U	10 U
Silver	10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	10 U	10 U	10 U	5 U
Thallium	30	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	20 U	20 U	20 U	20 U	10 U
Zinc	2,900	340	20 U	20 U	20 U	20 U	120	120	180	290	1,200	4,000	3,900	3,700	3,400	20 U
GENERAL CHEMISTRY (mg/L)																
Acidity as $CaCO_3$	2100	120	10 U	10 U	10 U	10 U	10 U	10 U	34	88	1,300	1,500	2,000	1,800	1,600	10 U
Alkalinity as $CaCO_3$	20 U	20 U	150	76	75	65	29	24	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Hardness	1,000	140	370	190	190	180	180	180	220	240	430	680	570	550	540	<10
Sulfate	5,800 J	33 J	220 J	99 J	230 J	110 J	160 J	180 J	260 J	670 J	2,400 J	3,200 J	4,800 J	5,800 J	4,300 J	2 UJ
Sulfide	1 UJ	1 UJ	1.2 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1.1 J

GPS = global positioning system
* = Results derived from Iron Test colormetric strips.
** = Reults derived from Manganese Test Colormetric strips.
J = Analyte detected, but concentration estimated due to potential accuracy or precision bias; or concentration reported above MDL but below established project reporting limit
U = Not Detected. Parameter was not detected at a concentration equal to or greater than the reported value.
mg/L = milligrams per liter
µS/cm = microsiemens per centimeter
NTU = nephelometer turbidity units
°C = degrees Celcius
mV = millivolts
-- = Sample was not analyzed for this parameter.

Table 6. Acid Mine Drainage Evaluation

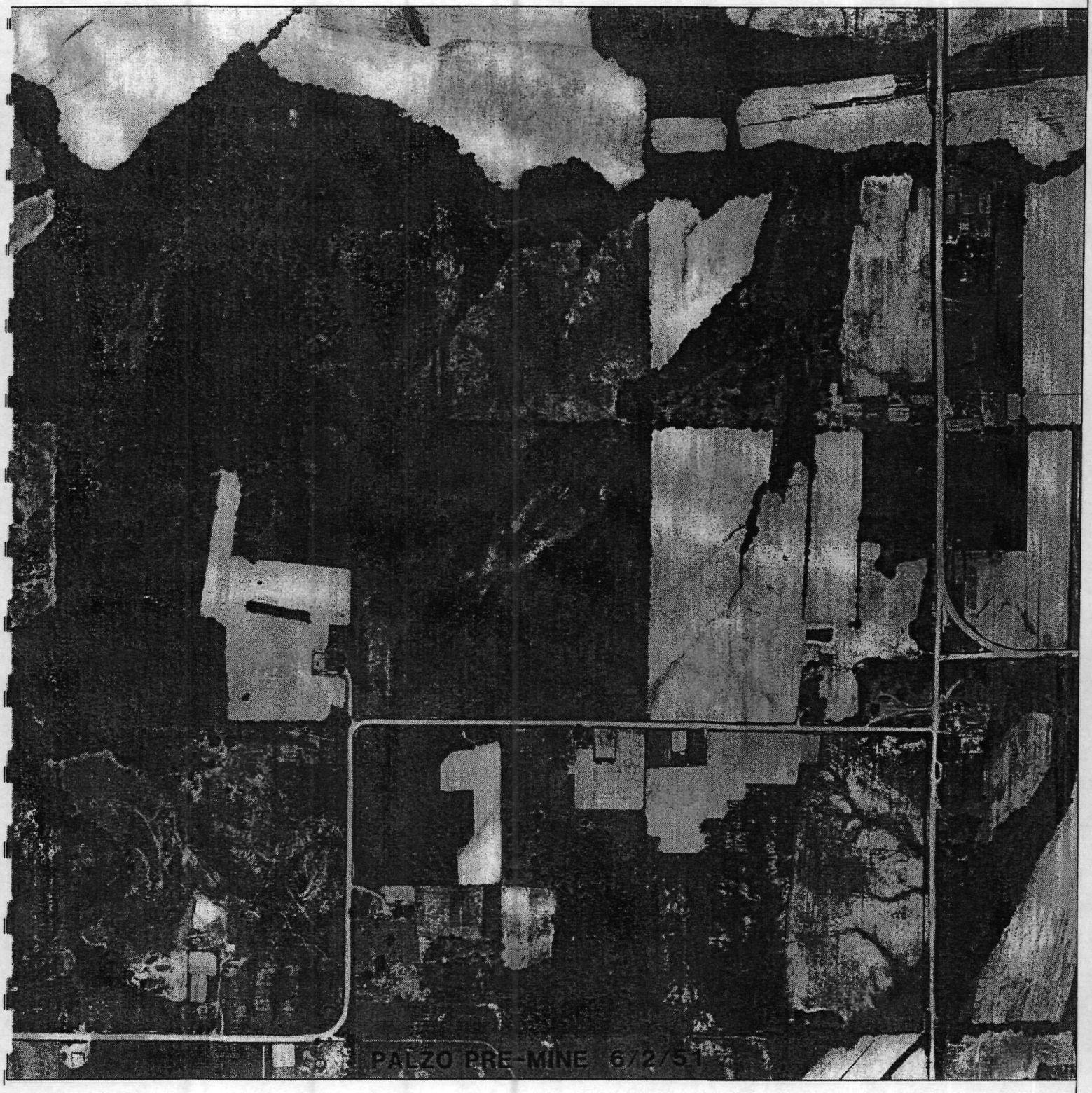
Palzo Mine Site - Shawnee National Forest, IL
PA/SI Report, January 2002

Location	Alkalinity (mg/L as CaCo3)	Acidity (mg/L as CaCo3)	Net Alkalinity (mg/L as CaCo3)	pH	Specific Conductivity (µS/cm)	Laboratory Analytical (mg/L)				Field Measuments (mg/L)	
						Aluminum	Iron	Manganese	Sulfate	Fe^{2+}	Mn
PD-1010	10	2,100	-2,090	2.41	4,300	150	300	62	5,800	50	100
WT-1004	10	2,000	-1,990	2.69	3,200	170	280	16	4,800	100 - 250	50 - 100
WT-1006	10	1,800	-1,790	2.58	3,200	170	200	13	5,800	25 - 50	50 - 100
WT-1009	10	1,600	-1,590	2.68	3,100	170	190	13	4,300	500	2
WT-1003	10	1,500	-1,490	2.66	3,100	160	120	16	3,200	5 - 50	25
SW-1001	10	1,300	-1,290	2.58	2,700	130	120	4.8	2,400	50	20 - 50
MW-10	10	640	-630	4.38	2,000	100	110	34	1,700	50	5
PD-1002	10	120	-110	3.4	560	15	4.7	5.5	33	3	5
SC-1025	10	88	-78	4.74	650	15	27	3.5	670	25	2
SC-1015	10	34	-24	5.28	530	6.6	14	2.9	260	10	2
SC-1017	24	5	19	5.9	450	3	6.1	1.8	180	3 - 10	0 - 2
SC-1020	29	5	24	5.18	420	5.4	5.4	1.4	160	3 - 10	0 - 2
SC-1023*	65	5	60	6.66	390	0.2	2	0.87	110	0 - 3	0
PD-1022	76	5	71	6.56	370	0.2	0.38	0.02	99	0	0
PD-1012	150	5	145	6.38	710	0.2	0.25	0.08	220	0	0

Assumes alkalinity = 10 mg/L where it was not detected at the 20 mg/L detection limit
Assumes acidity = 5 mg/L where it was not detected at the 10 mg/L detection limit
SC-1023* Background sample collected upstream of Plazo Mine Site

APPENDIX A [redacted]

APPENDIX A
Historical Aerials



indeco
1710 RIVER DRIVE
MOLINE, ILLINOIS 61265 (309)762-8863
A SUBSIDIARY OF JOHNSON BROS. CORPORATION

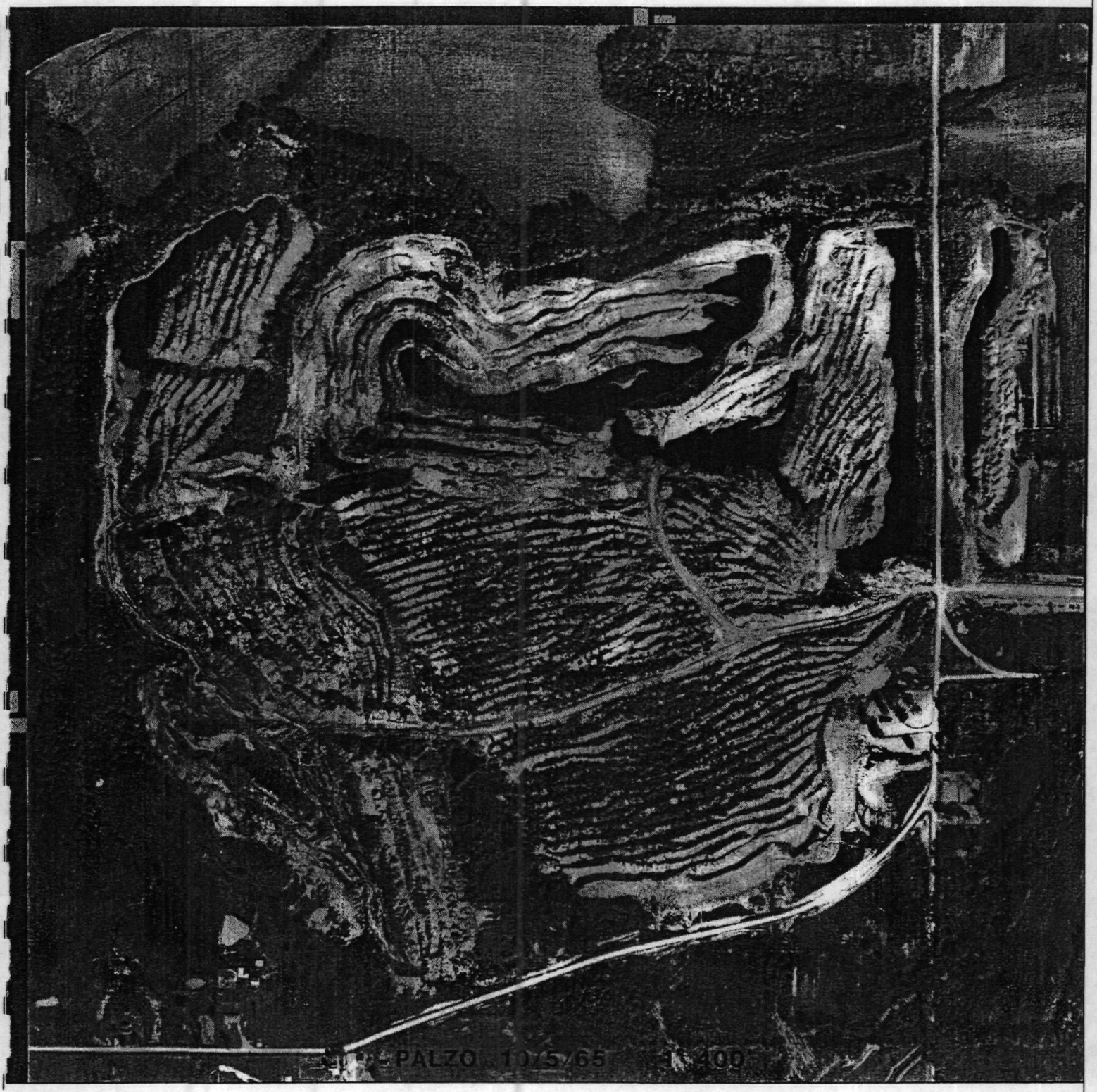
PALZO SITE
AERIAL PHOTO
PRE-MINING CONDITIONS
6/2/51

PLATE A-1

indeco
1710 RIVER DRIVE
MOLINE, ILLINOIS 61265 (309)762-8863
A SUBSIDIARY OF JOHNSON BROS. CORPORATION

PALZO SITE
AERIAL PHOTO
MINE SITE CONDITIONS
5/1/60

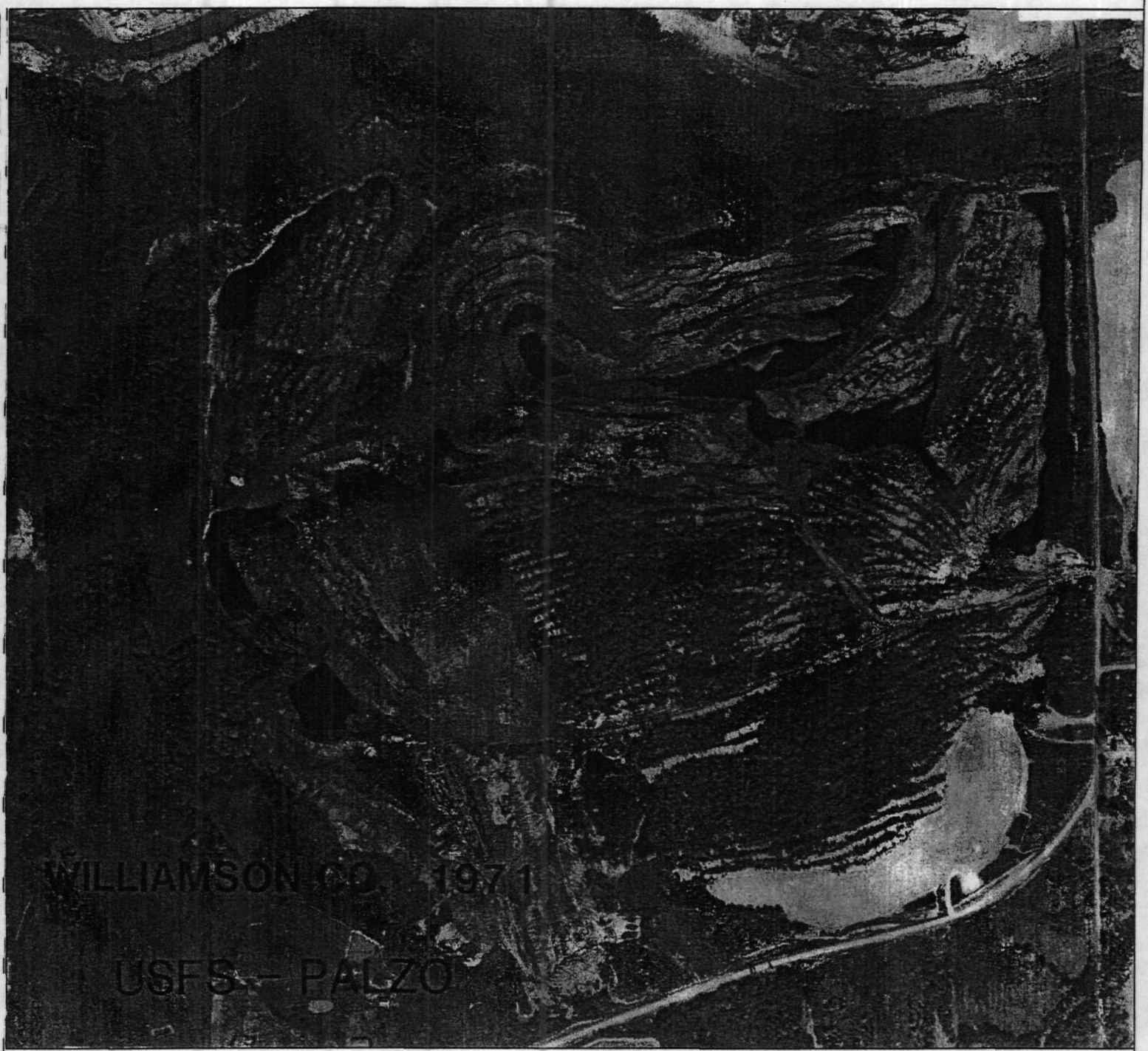
PLATE A-2



indeco
1710 RIVER DRIVE
MOLINE, ILLINOIS 61265 (309)762-8863
A SUBSIDIARY OF JOHNSON BROS. CORPORATION

PALZO SITE
AERIAL PHOTO
MINE SITE CONDITIONS
10/5/65

PLATE A-3



indeco
1710 RIVER DRIVE
MOLINE, ILLINOIS 61265 (309)762-8863
A SUBSIDIARY OF JOHNSON BROS. CORPORATION

PALZO SITE
AERIAL PHOTO
MINE SITE CONDITIONS
1971

PLATE A-4

indeco
1710 RIVER DRIVE
MOLINE, ILLINOIS 61265 (309)762-8863
A SUBSIDIARY OF JOHNSON BROS. CORPORATION

PALZO SITE
AERIAL PHOTO
MINE SITE CONDITIONS
3/14/79

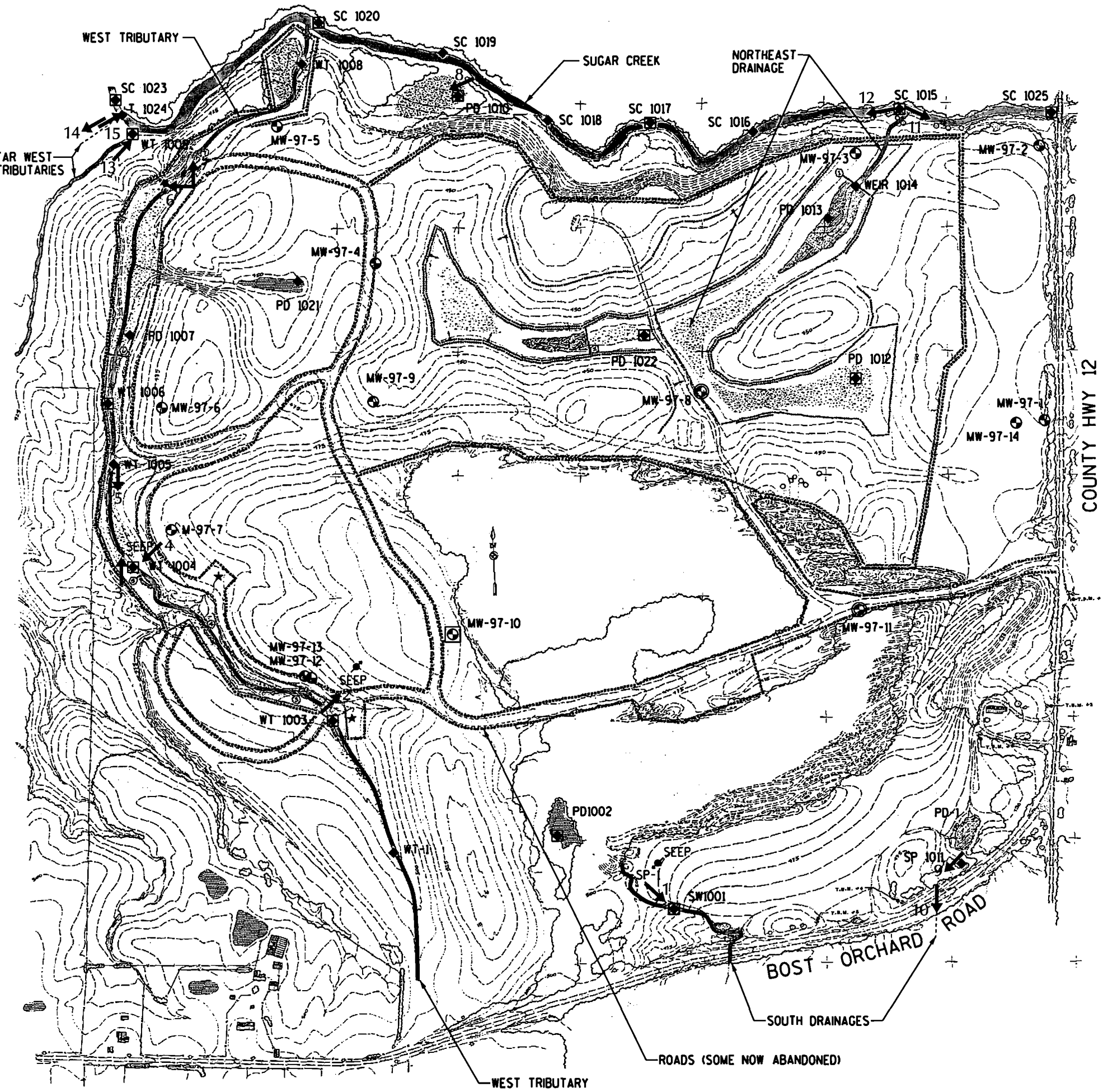
PLATE A-5

indeco
1710 RIVER DRIVE
MOLINE, ILLINOIS 61265 (309)762-8863
A SUBSIDIARY OF JOHNSON BROS. CORPORATION

PALZO SITE
AERIAL PHOTO
MINE SITE CONDITIONS
8/23/80

PLATE A-6

APPENDIX B
Site Inspection Photographs



LEGEND

- 12 → PHOTO NUMBER AND DIRECTION
- ◆ SURFACE FIELD SCREEN LOCATION
- □ SAMPLE LOCATION
- ◒ MONITORING WELL
- ○ MONITORING WELL FIELD SCREEN LOCATION
- SEEP LOCATION

N

SCALE: 1" = 427'

427 0 427

PALZO MINE SITE SOURCE: INDECO, 1998

TN & Associates, Inc.
Engineering and Science

PALZO MINE SITE
PRELIMINARY ASSESSMENT/SITE INSPECTION
DRAFT - JANUARY 2002

FIGURE B-1
SITE INSPECTION PHOTOS - NOV. 2001
SHAWNEE NATIONAL FOREST, ILLINOIS

FILE NAME: s:\Z NaturalResources\2001Projects\2001197 Shawnee NF-Palzo Mine\palzoB-1.dgn 03/14/2002 03:58:25 PM

Photograph 1: Looking downstream (southeast) at SW 1001 of drainage heading towards the southern boundary.

Photograph 2: Looking east from WT 1003 at a seepage that is flowing into the West Tributary.

Photograph 3: Looking north from WT 1004 at a seepage along the West Tributary.

Photograph 4: Looking west at sample location WT 1004 along the West Tributary.

Photograph 5: Looking south (towards WT 1004) at the seepage onto the West Tributary.

Photograph 6: Looking west at pond #3 at the north end of the West Tributary.

Photograph 7: Looking north at pond #3 at the north end of the West Tributary near Sugar Creek.

Photograph 8: Looking west from PD 1010, on the east end of pond #4 near Sugar Creek.

Photograph 9: Looking southwest at a drainage exiting the site under Bost Orchard Rd. in the southeast corner of the site.

Photograph 10: Looking south on the south side of Bost Orchard Rd. at the drainage leaving the site.

Photograph 11: Looking east along Sugar Creek just downstream from the Northeast Tributary.

Photograph 12: Looking west along Sugar Creek just upstream from the Northeast Tributary.

Photograph 13: Looking northeast from WT 1009 at the confluence of the polluted western most tributary with the cleaner Sugar Creek.

Photograph 14: Looking upstream (southwest) at the western most tributary near SC 1023.

Photograph 15: Looking downstream (northeast) at the western most tributary as it approaches Sugar Creek.

APPENDIX C
SI Laboratory Results

T N & Associates, Inc.
Engineering and Science

INTEROFFICE MEMORANDUM

DATE: December 10, 2001

TO: Nova Clite, Project Manager

FROM: Kate Burrall

CC: Chris Ohland, Senior Chemist

RE: **Palzo Mine Site, Shawnee National Forest Project 2001197, data validation**

One data package prepared by EnChem, Inc. of Madison, WI was reviewed for precision, accuracy, representativeness, completeness and compatibility (PARCC). Total metals, acidity, alkalinity, sulfate, and sulfide were completed and reported by EnChem. Samples for hardness analysis were subcontracted to another lab, as EnChem is unable to perform EPA method 130.1. These results will be reviewed when received.

The following information details each data package/sample delivery group (SDG) and the qualifications to the data deemed necessary after review. The following analyses and recoveries were reviewed for each package, if applicable:

- Holding time deficiencies
- Laboratory control sample (LCS)
- Matrix spike/matrix spike duplicate (MS/MSD)
- Laboratory duplicate recoveries
- Field duplicate recoveries
- Method blank recoveries
- Instrument detection limits (IDL)

EnChem SDG 913932 – Metals

This SDG includes 19 surface water samples for total metals analysis.

Field duplicate relative percent differences (RPD) were within acceptable limits (<40%) of the parent sample for all parameters. No qualification was necessary

No compounds were detected in the equipment rinsate sample.

LCS, MS/MSD, lab duplicate, holding times, method blank, and calibration results were acceptable; no qualification was necessary.

Form 1 pages were signed to indicate no validation changes were necessary.

EnChem SDG 913932 – General Chemistry

This SDG includes 19 water samples for acidity, alkalinity, sulfate, and sulfide analyses.

Field duplicate results were outside acceptable limits (<40%) for sulfate (80%) when compared to parent sample. All field results were qualified "J" to indicate non-heterogeneity of the samples.

MS/MSD precision was not acceptable for sulfide. Although spike recovery was within range (80-110%), RPD was outside acceptable range (>10%). The parent sample, SC-1025, was qualified "J".

The detection of sulfide in the equipment rinsate sample resulted in an action level of 5.5 mg/L. Sample PD-1012 was qualified "U" for the sulfide action limit. No other samples were affected by the action limit.

Sulfide samples were analyzed two or three days later than the acceptable holding time of seven days due to miscommunication within the laboratory. Samples analyzed after acceptable holding time cannot be considered as reliable as samples analyzed within holding time, as the sample may have degraded or converted. Only one field sample and the equipment rinsate sample had detectable amounts of sulfide. All field results were qualified "UJ" to indicate results are estimated due to missed hold times.

Method blanks, calibrations, and LCS results were acceptable; no qualification was necessary.

Form 1 pages were updated and signed to indicate validation changes.

FORM 1 RESULTS

En Chem, Inc.

SDG # 913932

MW-10

PD-1002

PD-1010

PD-1022

PD-10229

SC-1015

SC-1017

SC-1020

SC-1023

SC-1025

SW-1001

WT-1003

WT-1004

WT-1006

WT-1009

ER-1

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920-469-2436 • Fax: 920-469-8827
800-7-ENCHEM

EN CHEM INC.

Madison Office & Laboratory
525 Science Drive
Madison, WI 53711
608-232-3300 • Fax: 608-233-0502
888-5-ENCHEM

- Analytical Report -

Project Name : PALZO MINE SITE
Project Number : 2001197
Field ID : MW-10
Lab Sample Number : 913932-017
Lab Project Number : 913932

Submitter : TN & ASSOCIATES - MILWAUKEE
Report Date : 12/5/01
Collection Date : 11/7/01
Matrix Type : WATER
WI DNR LAB ID : 113172950

Inorganic Results

Test	Result	EQL	Units	Code	Analysis Date	Prep Method	Analysis Method
Aluminum	100000	400	ug/L		11/21/01	SW846 3015	SW846 6010B
Antimony	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Arsenic	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Beryllium	20	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Cadmium	25	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Calcium	270000	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Chromium	< 6.0	6.0	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Copper	24	20	ug/L		11/21/01	SW846 3015	SW846 6010B
Iron	110000	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Lead	< 10	10	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Manganese	34000	20	ug/L		11/26/01	SW846 3015	SW846 6010B
Mercury	< 0.20	0.20	ug/L		11/27/01	SW846 7470A	SW846 7470A
Nickel	800	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Selenium	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Silver	< 10	10	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Thallium	23	20	ug/L		11/21/01	SW846 3015	SW846 6010B
Zinc	2000	40	ug/L		11/21/01	SW846 3015	SW846 6010B
Acidity as CaCO3	640	10	mg/L		11/16/01	EPA 305.1	EPA 305.1
Alkalinity as CaCO3	< 20	20	mg/L		11/16/01	EPA 310.2	EPA 310.2
Sulfate	1700 J	1000	mg/L		11/21/01	EPA 300.0	EPA 300.0
Sulfide	< 1.0 UJ	1.0	mg/L	H(2)	11/16/01	EPA 376.1	EPA 376.1

KMB
12-10-01

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800-7-ENCHEM

EN CHEM INC.

Madison Office & Laboratory
525 Science Drive
Madison, WI 53711
608-232-3300 • Fax: 608-233-0502
888-5-ENCHEM

- Analytical Report -

Project Name : PALZO MINE SITE
Project Number : 2001197
Field ID : PD-1002
Lab Sample Number : 913932-002
Lab Project Number : 913932

Submitter : TN & ASSOCIATES - MILWAUKEE
Report Date : 12/5/01
Collection Date : 11/6/01
Matrix Type : WATER
WI DNR LAB ID : 113172950

Inorganic Results

Test	Result	EQL	Units	Code	Analysis Date	Prep Method	Analysis Method
Aluminum	15000	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Antimony	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Arsenic	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Beryllium	6.6	1.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Cadmium	14	1.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Calcium	33000	100	ug/L		11/21/01	SW846 3015	SW846 6010B
Chromium	< 3.0	3.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Copper	11	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Iron	4700	100	ug/L		11/21/01	SW846 3015	SW846 6010B
Lead	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Manganese	5500	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Mercury	< 0.20	0.20	ug/L		11/27/01	SW846 7470A	SW846 7470A
Nickel	140	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Selenium	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Silver	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Thallium	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Zinc	340	20	ug/L		11/21/01	SW846 3015	SW846 6010B
Acidity as CaCO3	120	10	mg/L		11/16/01	EPA 305.1	EPA 305.1
Alkalinity as CaCO3	< 20	20	mg/L		11/16/01	EPA 310.2	EPA 310.2
Sulfate	33 J	20	mg/L		11/19/01	EPA 300.0	EPA 300.0
Sulfide	< 1.0 UJ	1.0	mg/L	H(3)	11/16/01	EPA 376.1	EPA 376.1

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Project Name : PALZO MINE SITE
Project Number : 2001197
Field ID : PD-1010
Lab Sample Number : 913932-006
Lab Project Number : 913932

Submitter : TN & ASSOCIATES - MILWAUKEE
Report Date : 12/5/01
Collection Date : 11/6/01
Matrix Type : WATER
WI DNR LAB ID : 113172950

Inorganic Results

Test	Result	EQL	Units	Code	Analysis Date	Prep Method	Analysis Method
Aluminum	150000	400	ug/L		11/21/01	SW846 3015	SW846 6010B
Antimony	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Arsenic	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Beryllium	22	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Cadmium	28	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Calcium	200000	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Chromium	45	6.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Copper	110	20	ug/L		11/21/01	SW846 3015	SW846 6010B
Iron	300000	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Lead	< 10	10	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Manganese	62000	20	ug/L		11/26/01	SW846 3015	SW846 6010B
Mercury	< 0.20	0.20	ug/L		11/27/01	SW846 7470A	SW846 7470A
Nickel	1200	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Selenium	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Silver	< 10	10	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Thallium	30	20	ug/L		11/21/01	SW846 3015	SW846 6010B
Zinc	2900	40	ug/L		11/21/01	SW846 3015	SW846 6010B
Acidity as CaCO3	2100	10	mg/L		11/16/01	EPA 305.1	EPA 305.1
Alkalinity as CaCO3	< 20	20	mg/L		11/16/01	EPA 310.2	EPA 310.2
Sulfate	5800 J	400	mg/L		11/19/01	EPA 300.0	EPA 300.0
Sulfide	< 1.0 UJ	1.0	mg/L	H(3)	11/16/01	EPA 376.1	EPA 376.1

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Project Name : PALZO MINE SITE
Project Number : 2001197
Field ID : PD-1012
Lab Sample Number : 913932-012
Lab Project Number : 913932

Submitter : TN & ASSOCIATES - MILWAUKEE
Report Date : 12/5/01
Collection Date : 11/7/01
Matrix Type : WATER
WI DNR LAB ID : 113172950

Inorganic Results

Test	Result	EQL	Units	Code	Analysis Date	Prep Method	Analysis Method
Aluminum	< 200	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Antimony	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Arsenic	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Beryllium	< 1.0	1.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Cadmium	< 1.0	1.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Calcium	140000	100	ug/L		11/21/01	SW846 3015	SW846 6010B
Chromium	< 3.0	3.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Copper	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Iron	250	100	ug/L		11/21/01	SW846 3015	SW846 6010B
Lead	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Manganese	84	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Mercury	< 0.20	0.20	ug/L		11/27/01	SW846 7470A	SW846 7470A
Nickel	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Selenium	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Silver	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Thallium	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Zinc	< 20	20	ug/L		11/21/01	SW846 3015	SW846 6010B
Acidity as CaCO3	< 10	10	mg/L		11/16/01	EPA 305.1	EPA 305.1
Alkalinity as CaCO3	150	20	mg/L		11/16/01	EPA 310.2	EPA 310.2
Sulfate	220 J	20	mg/L		11/16/01	EPA 300.0	EPA 300.0
Sulfide	1.2 UJ	1.0	mg/L	H(2)	11/16/01	EPA 376.1	EPA 376.1

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Project Name : PALZO MINE SITE
Project Number : 2001197
Field ID : PD-1022
Lab Sample Number : 913932-008
Lab Project Number : 913932

Submitter : TN & ASSOCIATES - MILWAUKEE
Report Date : 12/5/01
Collection Date : 11/7/01
Matrix Type : WATER
WI DNR LAB ID : 113172950

Inorganic Results

Test	Result	EQL	Units	Code	Analysis Date	Prep Method	Analysis Method
Aluminum	< 200	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Antimony	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Arsenic	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Beryllium	< 1.0	1.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Cadmium	< 1.0	1.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Calcium	71000	100	ug/L		11/21/01	SW846 3015	SW846 6010B
Chromium	< 3.0	3.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Copper	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Iron	380	100	ug/L		11/21/01	SW846 3015	SW846 6010B
Lead	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Manganese	16	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Mercury	< 0.20	0.20	ug/L		11/27/01	SW846 7470A	SW846 7470A
Nickel	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Selenium	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Silver	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Thallium	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Zinc	< 20	20	ug/L		11/21/01	SW846 3015	SW846 6010B
Acidity as CaCO3	< 10	10	mg/L		11/16/01	EPA 305.1	EPA 305.1
Alkalinity as CaCO3	76	20	mg/L		11/16/01	EPA 310.2	EPA 310.2
Sulfate	99 J	20	mg/L		11/16/01	EPA 300.0	EPA 300.0
Sulfide	< 1.0 UJ	1.0	mg/L	H(2)	11/16/01	EPA 376.1	EPA 376.1

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Project Name : PALZO MINE SITE
Project Number : 2001197
Field ID : PD-10229
Lab Sample Number : 913932-007
Lab Project Number : 913932

Submitter : TN & ASSOCIATES - MILWAUKEE
Report Date : 12/5/01
Collection Date : 11/7/01
Matrix Type : WATER
WI DNR LAB ID : 113172950

Inorganic Results

Test	Result	EQL	Units	Code	Analysis Date	Prep Method	Analysis Method
Aluminum	< 200	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Antimony	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Arsenic	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Beryllium	< 1.0	1.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Cadmium	< 1.0	1.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Calcium	70000	100	ug/L		11/21/01	SW846 3015	SW846 6010B
Chromium	< 3.0	3.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Copper	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Iron	300	100	ug/L		11/21/01	SW846 3015	SW846 6010B
Lead	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Manganese	11	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Mercury	< 0.20	0.20	ug/L		11/27/01	SW846 7470A	SW846 7470A
Nickel	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Selenium	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Silver	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Thallium	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Zinc	< 20	20	ug/L		11/21/01	SW846 3015	SW846 6010B
Acidity as CaCO3	< 10	10	mg/L		11/16/01	EPA 305.1	EPA 305.1
Alkalinity as CaCO3	75	20	mg/L		11/16/01	EPA 310.2	EPA 310.2
Sulfate	230 J	20	mg/L		11/16/01	EPA 300.0	EPA 300.0
Sulfide	< 1.0 UJ	1.0	mg/L	H(2)	11/16/01	EPA 376.1	EPA 376.1

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Project Name : PALZO MINE SITE
Project Number : 2001197
Field ID : SC-1015
Lab Sample Number : 913932-015
Lab Project Number : 913932

Submitter : TN & ASSOCIATES - MILWAUKEE
Report Date : 12/5/01
Collection Date : 11/7/01
Matrix Type : WATER
WI DNR LAB ID : 113172950

Inorganic Results

Test	Result	EQL	Units	Code	Analysis Date	Prep Method	Analysis Method
Aluminum	6600	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Antimony	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Arsenic	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Beryllium	1.6	1.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Cadmium	3.7	1.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Calcium	54000	100	ug/L		11/21/01	SW846 3015	SW846 6010B
Chromium	< 3.0	3.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Copper	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Iron	14000	100	ug/L		11/21/01	SW846 3015	SW846 6010B
Lead	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Manganese	2900	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Mercury	< 0.20	0.20	ug/L		11/27/01	SW846 7470A	SW846 7470A
Nickel	71	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Selenium	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Silver	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Thallium	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Zinc	180	20	ug/L		11/21/01	SW846 3015	SW846 6010B
Acidity as CaCO3	34	10	mg/L		11/16/01	EPA 305.1	EPA 305.1
Alkalinity as CaCO3	< 20	20	mg/L		11/16/01	EPA 310.2	EPA 310.2
Sulfate	260 J	20	mg/L		11/17/01	EPA 300.0	EPA 300.0
Sulfide	< 1.0 UJ	1.0	mg/L	H(2)	11/16/01	EPA 376.1	EPA 376.1

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Project Name : PALZO MINE SITE
Project Number : 2001197
Field ID : SC-1017
Lab Sample Number : 913932-013
Lab Project Number : 913932

Submitter : TN & ASSOCIATES - MILWAUKEE
Report Date : 12/5/01
Collection Date : 11/7/01
Matrix Type : WATER
WI DNR LAB ID : 113172950

Inorganic Results

Test	Result	EQL	Units	Code	Analysis Date	Prep Method	Analysis Method
Aluminum	3000	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Antimony	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Arsenic	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Beryllium	< 1.0	1.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Cadmium	2.4	1.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Calcium	43000	100	ug/L		11/21/01	SW846 3015	SW846 6010B
Chromium	< 3.0	3.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Copper	10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Iron	6100	100	ug/L		11/21/01	SW846 3015	SW846 6010B
Lead	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Manganese	1800	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Mercury	< 0.20	0.20	ug/L		11/27/01	SW846 7470A	SW846 7470A
Nickel	44	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Selenium	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Silver	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Thallium	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Zinc	120	20	ug/L		11/21/01	SW846 3015	SW846 6010B
Acidity as CaCO3	< 10	10	mg/L		11/16/01	EPA 305.1	EPA 305.1
Alkalinity as CaCO3	24	20	mg/L		11/16/01	EPA 310.2	EPA 310.2
Sulfate	180 J	20	mg/L		11/17/01	EPA 300.0	EPA 300.0
Sulfide	< 1.0 UJ	1.0	mg/L	H(2)	11/16/01	EPA 376.1	EPA 376.1

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Project Name : PALZO MINE SITE
Project Number : 2001197
Field ID : SC-1020
Lab Sample Number : 913932-016
Lab Project Number : 913932

Submitter : TN & ASSOCIATES - MILWAUKEE
Report Date : 12/5/01
Collection Date : 11/7/01
Matrix Type : WATER
WI DNR LAB ID : 113172950

Inorganic Results

Test	Result	EQL	Units	Code	Analysis Date	Prep Method	Analysis Method
Aluminum	5400	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Antimony	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Arsenic	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Beryllium	1.2	1.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Cadmium	2.7	1.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Calcium	42000	100	ug/L		11/21/01	SW846 3015	SW846 6010B
Chromium	< 3.0	3.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Copper	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Iron	5400	100	ug/L		11/21/01	SW846 3015	SW846 6010B
Lead	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Manganese	1400	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Mercury	< 0.20	0.20	ug/L		11/27/01	SW846 7470A	SW846 7470A
Nickel	38	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Selenium	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Silver	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Thallium	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Zinc	120	20	ug/L		11/21/01	SW846 3015	SW846 6010B
Acidity as CaCO3	< 10	10	mg/L		11/16/01	EPA 305.1	EPA 305.1
Alkalinity as CaCO3	29	20	mg/L		11/16/01	EPA 310.2	EPA 310.2
Sulfate	160 J	20	mg/L		11/17/01	EPA 300.0	EPA 300.0
Sulfide	< 1.0 UJ	1.0	mg/L	H(2)	11/16/01	EPA 376.1	EPA 376.1

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Project Name : PALZO MINE SITE
Project Number : 2001197
Field ID : SC-1023
Lab Sample Number : 913932-014
Lab Project Number : 913932

Submitter : TN & ASSOCIATES - MILWAUKEE
Report Date : 12/5/01
Collection Date : 11/7/01
Matrix Type : WATER
WI DNR LAB ID : 113172950

Inorganic Results

Test	Result	EQL	Units	Code	Analysis Date	Prep Method	Analysis Method
Aluminum	< 200	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Antimony	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Arsenic	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Beryllium	< 1.0	1.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Cadmium	< 1.0	1.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Calcium	39000	100	ug/L		11/21/01	SW846 3015	SW846 6010B
Chromium	< 3.0	3.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Copper	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Iron	2000	100	ug/L		11/21/01	SW846 3015	SW846 6010B
Lead	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Manganese	870	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Mercury	< 0.20	0.20	ug/L		11/27/01	SW846 7470A	SW846 7470A
Nickel	6.2	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Selenium	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Silver	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Thallium	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Zinc	< 20	20	ug/L		11/21/01	SW846 3015	SW846 6010B
Acidity as CaCO3	< 10	10	mg/L		11/16/01	EPA 305.1	EPA 305.1
Alkalinity as CaCO3	65	20	mg/L		11/16/01	EPA 310.2	EPA 310.2
Sulfate	110 J	20	mg/L		11/17/01	EPA 300.0	EPA 300.0
Sulfide	< 1.0 UJ	1.0	mg/L	H(2)	11/16/01	EPA 376.1	EPA 376.1

KMB
12-10-01

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- Analytical Report -

Project Name : PALZO MINE SITE
Project Number : 2001197
Field ID : SC-1025
Lab Sample Number : 913932-009
Lab Project Number : 913932

Submitter : TN & ASSOCIATES - MILWAUKEE
Report Date : 12/5/01
Collection Date : 11/7/01
Matrix Type : WATER
WI DNR LAB ID : 113172950

Inorganic Results

Test	Result		EQL	Units	Code	Analysis Date	Prep Method	Analysis Method
Aluminum	15000		200	ug/L		11/21/01	SW846 3015	SW846 6010B
Antimony	< 10		10	ug/L		11/21/01	SW846 3015	SW846 6010B
Arsenic	< 10		10	ug/L		11/21/01	SW846 3015	SW846 6010B
Beryllium	3.0		1.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Cadmium	6.3		1.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Calcium	58000		100	ug/L		11/21/01	SW846 3015	SW846 6010B
Chromium	5.2		3.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Copper	< 10		10	ug/L		11/21/01	SW846 3015	SW846 6010B
Iron	27000		100	ug/L		11/21/01	SW846 3015	SW846 6010B
Lead	< 5.0		5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Manganese	3500		2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Mercury	< 0.20		0.20	ug/L		11/27/01	SW846 7470A	SW846 7470A
Nickel	110		5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Selenium	< 10		10	ug/L		11/21/01	SW846 3015	SW846 6010B
Silver	< 5.0		5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Thallium	< 10		10	ug/L		11/21/01	SW846 3015	SW846 6010B
Zinc	290		20	ug/L		11/21/01	SW846 3015	SW846 6010B
Acidity as CaCO3	88		10	mg/L		11/16/01	EPA 305.1	EPA 305.1
Alkalinity as CaCO3	< 20		20	mg/L		11/16/01	EPA 310.2	EPA 310.2
Sulfate	670	J	200	mg/L	*	11/19/01	EPA 300.0	EPA 300.0
Sulfide	< 1.0	UJ	1.0	mg/L	H(2)	11/16/01	EPA 376.1	EPA 376.1

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12-10-01

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- Analytical Report -

Project Name : PALZO MINE SITE
Project Number : 2001197
Field ID : SW-1001
Lab Sample Number : 913932-001
Lab Project Number : 913932

Submitter : TN & ASSOCIATES - MILWAUKEE
Report Date : 12/5/01
Collection Date : 11/6/01
Matrix Type : WATER
WI DNR LAB ID : 113172950

Inorganic Results

Test	Result	EQL	Units	Code	Analysis Date	Prep Method	Analysis Method
Aluminum	130000	400	ug/L		11/21/01	SW846 3015	SW846 6010B
Antimony	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Arsenic	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Beryllium	15	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Cadmium	43	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Calcium	180000	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Chromium	62	6.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Copper	250	20	ug/L		11/21/01	SW846 3015	SW846 6010B
Iron	120000	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Lead	< 10	10	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Manganese	4800	4.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Mercury	< 0.20	0.20	ug/L		11/27/01	SW846 7470A	SW846 7470A
Nickel	600	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Selenium	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Silver	< 10	10	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Thallium	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Zinc	1200	40	ug/L		11/21/01	SW846 3015	SW846 6010B
Acidity as CaCO3	1300	10	mg/L		11/16/01	EPA 305.1	EPA 305.1
Alkalinity as CaCO3	< 20	20	mg/L		11/16/01	EPA 310.2	EPA 310.2
Sulfate	2400 J	200	mg/L		11/19/01	EPA 300.0	EPA 300.0
Sulfide	< 1.0 UJ	1.0	mg/L	H(3)	11/16/01	EPA 376.1	EPA 376.1

KmB
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- Analytical Report -

Project Name : PALZO MINE SITE
Project Number : 2001197
Field ID : WT-1003
Lab Sample Number : 913932-003
Lab Project Number : 913932

Submitter : TN & ASSOCIATES - MILWAUKEE
Report Date : 12/5/01
Collection Date : 11/6/01
Matrix Type : WATER
WI DNR LAB ID : 113172950

Inorganic Results

Test	Result	EQL	Units	Code	Analysis Date	Prep Method	Analysis Method
Aluminum	160000	400	ug/L		11/21/01	SW846 3015	SW846 6010B
Antimony	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Arsenic	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Beryllium	21	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Cadmium	160	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Calcium	170000	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Chromium	160	6.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Copper	450	20	ug/L		11/21/01	SW846 3015	SW846 6010B
Iron	120000	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Lead	< 10	10	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Manganese	8900	4.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Mercury	< 0.20	0.20	ug/L		11/27/01	SW846 7470A	SW846 7470A
Nickel	890	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Selenium	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Silver	< 10	10	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Thallium	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Zinc	4000	40	ug/L		11/21/01	SW846 3015	SW846 6010B
Acidity as CaCO3	1500	10	mg/L		11/16/01	EPA 305.1	EPA 305.1
Alkalinity as CaCO3	< 20	20	mg/L		11/16/01	EPA 310.2	EPA 310.2
Sulfate	3200 J	200	mg/L		11/19/01	EPA 300.0	EPA 300.0
Sulfide	< 1.0 UJ	1.0	mg/L	H(3)	11/16/01	EPA 376.1	EPA 376.1

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- Analytical Report -

Project Name : PALZO MINE SITE
Project Number : 2001197
Field ID : WT-1004
Lab Sample Number : 913932-004
Lab Project Number : 913932

Submitter : TN & ASSOCIATES - MILWAUKEE
Report Date : 12/5/01
Collection Date : 11/6/01
Matrix Type : WATER
WI DNR LAB ID : 113172950

Inorganic Results

Test	Result	EQL	Units	Code	Analysis Date	Prep Method	Analysis Method
Aluminum	170000	400	ug/L		11/21/01	SW846 3015	SW846 6010B
Antimony	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Arsenic	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Beryllium	26	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Cadmium	130	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Calcium	160000	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Chromium	83	6.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Copper	290	20	ug/L		11/21/01	SW846 3015	SW846 6010B
Iron	280000	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Lead	< 10	10	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Manganese	16000	4.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Mercury	< 0.20	0.20	ug/L		11/27/01	SW846 7470A	SW846 7470A
Nickel	1100	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Selenium	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Silver	< 10	10	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Thallium	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Zinc	3900	40	ug/L		11/21/01	SW846 3015	SW846 6010B
Acidity as CaCO3	2000	10	mg/L		11/16/01	EPA 305.1	EPA 305.1
Alkalinity as CaCO3	< 20	20	mg/L		11/16/01	EPA 310.2	EPA 310.2
Sulfate	4800 J	400	mg/L		11/19/01	EPA 300.0	EPA 300.0
Sulfide	< 1.0 UJ	1.0	mg/L	H(3)	11/16/01	EPA 376.1	EPA 376.1

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12-10-01

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- Analytical Report -

Project Name : PALZO MINE SITE
Project Number : 2001197
Field ID : WT-1006
Lab Sample Number : 913932-019
Lab Project Number : 913932

Submitter : TN & ASSOCIATES - MILWAUKEE
Report Date : 12/5/01
Collection Date : 11/7/01
Matrix Type : WATER
WI DNR LAB ID : 113172950

Inorganic Results

Test	Result	EQL	Units	Code	Analysis Date	Prep Method	Analysis Method
Aluminum	170000	400	ug/L		11/21/01	SW846 3015	SW846 6010B
Antimony	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Arsenic	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Beryllium	25	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Cadmium	120	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Calcium	140000	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Chromium	78	6.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Copper	260	20	ug/L		11/21/01	SW846 3015	SW846 6010B
Iron	200000	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Lead	< 10	10	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Manganese	13000	4.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Mercury	< 0.20	0.20	ug/L		11/27/01	SW846 7470A	SW846 7470A
Nickel	1000	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Selenium	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Silver	< 10	10	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Thallium	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Zinc	3700	40	ug/L		11/21/01	SW846 3015	SW846 6010B
Acidity as CaCO3	1800	10	mg/L		11/16/01	EPA 305.1	EPA 305.1
Alkalinity as CaCO3	< 20	20	mg/L		11/16/01	EPA 310.2	EPA 310.2
Sulfate	5800 J	400	mg/L		11/19/01	EPA 300.0	EPA 300.0
Sulfide	< 1.0 UJ	1.0	mg/L	H(2)	11/16/01	EPA 376.1	EPA 376.1

KmB
12-10-01

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- Analytical Report -

Project Name : PALZO MINE SITE
Project Number : 2001197
Field ID : ER-1
Lab Sample Number : 913932-018
Lab Project Number : 913932

Submitter : TN & ASSOCIATES - MILWAUKEE
Report Date : 12/5/01
Collection Date : 11/7/01
Matrix Type : WATER
WI DNR LAB ID : 113172950

Inorganic Results

Test	Result	EQL	Units	Code	Analysis Date	Prep Method	Analysis Method
Aluminum	< 200	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Antimony	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Arsenic	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Beryllium	< 1.0	1.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Cadmium	< 1.0	1.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Calcium	< 100	100	ug/L		11/21/01	SW846 3015	SW846 6010B
Chromium	< 3.0	3.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Copper	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Iron	< 100	100	ug/L		11/21/01	SW846 3015	SW846 6010B
Lead	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Manganese	< 2.0	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Mercury	< 0.20	0.20	ug/L		11/27/01	SW846 7470A	SW846 7470A
Nickel	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Selenium	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Silver	< 5.0	5.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Thallium	< 10	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Zinc	< 20	20	ug/L		11/21/01	SW846 3015	SW846 6010B
Acidity as CaCO3	< 10	10	mg/L		11/16/01	EPA 305.1	EPA 305.1
Alkalinity as CaCO3	< 20	20	mg/L		11/16/01	EPA 310.2	EPA 310.2
Sulfate	< 2.0	2.0	mg/L		11/17/01	EPA 300.0	EPA 300.0
Sulfide	1.1	1.0	mg/L	H(2)	11/16/01	EPA 376.1	EPA 376.1

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- Analytical Report -

Project Name : PALZO MINE SITE
Project Number : 2001197
Field ID : WT-1009
Lab Sample Number : 913932-005
Lab Project Number : 913932

Submitter : TN & ASSOCIATES - MILWAUKEE
Report Date : 12/5/01
Collection Date : 11/6/01
Matrix Type : WATER
WI DNR LAB ID : 113172950

Inorganic Results

Test	Result	EQL	Units	Code	Analysis Date	Prep Method	Analysis Method
Aluminum	170000	400	ug/L		11/21/01	SW846 3015	SW846 6010B
Antimony	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Arsenic	22	20	ug/L		11/21/01	SW846 3015	SW846 6010B
Beryllium	27	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Cadmium	86	2.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Calcium	160000	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Chromium	57	6.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Copper	95	20	ug/L		11/21/01	SW846 3015	SW846 6010B
Iron	190000	200	ug/L		11/21/01	SW846 3015	SW846 6010B
Lead	< 10	10	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Manganese	13000	4.0	ug/L		11/21/01	SW846 3015	SW846 6010B
Mercury	< 0.20	0.20	ug/L		11/27/01	SW846 7470A	SW846 7470A
Nickel	910	10	ug/L		11/21/01	SW846 3015	SW846 6010B
Selenium	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Silver	< 10	10	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Thallium	< 20	20	ug/L	ED	11/21/01	SW846 3015	SW846 6010B
Zinc	3400	40	ug/L		11/21/01	SW846 3015	SW846 6010B
Acidity as CaCO3	1600	10	mg/L		11/16/01	EPA 305.1	EPA 305.1
Alkalinity as CaCO3	< 20	20	mg/L		11/16/01	EPA 310.2	EPA 310.2
Sulfate	4300 J	400	mg/L		11/19/01	EPA 300.0	EPA 300.0
Sulfide	< 1.0 UJ	1.0	mg/L	H(3)	11/16/01	EPA 376.1	EPA 376.1

KmB
12-10-01

CHAIN OF CUSTODY FORMS

(Please Print Legibly)

Company Name: TN & Associates

Branch or Location: Milwaukee

Project Contact: Kate Burell

Telephone: 414-257-4200

Project Number: 2001197

Project Name: Palzo Mine Site

Project State: ILL

Sampled By (Print): John Bruskewitz

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CHAIN OF CUSTODY

74251

P.O. # _____ Quote # _____

Mail Report To: Kate Burell

Company: TN & Associates

Address: 1033 N Mayfair Suite 200 Milwaukee WI 53226

Invoice To: Accounts Payable

Company: TN & Associates

Address: ~~1033~~ 1033 N Mayfair Rd Suite 200 Milwaukee WI 53226

Mail Invoice To: _____

*Preservation Codes

A=None B=HCL C=H2SO4 D=HNO3 E=EnCore F=Methanol G=NaOH
H = Sodium Bisulfate Solution I = Other 12 N Acetate, NaOH

Data Package Options
(please circle if requested)
Results Only
EnChem Level III (Subject to Surcharge)
EnChem Level IV (Subject to Surcharge)

Regulatory Program: UST, RCRA, SDWA, NPDES, CERCLA

Matrix Codes: W=Water, S=Soil, A=Air, C=Charcoal, B=Biota, Sl=Sludge

LABORATORY ID (Lab Use Only)	FIELD ID	COLLECTION DATE	COLLECTION TIME	MATRIX	FILTERED? (YES/NO)	Hardness Metals	Sulfide	Acidity, Alkalinity, Solids					TOTAL # OF BOTTLES SENT	CLIENT COMMENTS	LAB COMMENTS (Lab Use Only)
	PRESERVATION (CODE)*					N	N	N	-	-	-	-	-		
						D	I	A							
913932-001	SW-1001	11/6/01	1029	W		X	X	X					3		
-002	PD-1002	11/06/01	1054	W		X	X	X					3		
-003	WT-1003	11/06/01	1335	W		X	X	X					3		
-004	WT-1004	11/06/01	1414	W		X	X	X					3		
-005	WT-1009	11/06/01	1600	W		X	X	X					3		
-006	PD-1010	11/06/01	1628	W		X	X	X					3		
-007	PD-10229	11/07/01	1425	W		X	X	X					3		
-008	PD-1022	11/07/01	1422	W		X	X	X					3		
009-010-011	SC-1025	11/07/01	1333	W		X	X	X					9	MS/MSD	
-012	PD-1012	11/07/01	0845	W		X	X	X					3		
-013	SC-1017	11/07/01	1010	W		X	X	X					3		
-014	SC-1023	11/07/01	1235	W		X	X	X					3		

Rush Turnaround Time Requested (TAT) - Prelim
(Rush TAT subject to approval/surcharge)
Date Needed: _____
Transmit Prelim Rush Results by (circle):
Phone Fax E-Mail
Phone #: _____
Fax #: _____
E-Mail Address: _____

Samples on HOLD are subject to special pricing and release of liability

Relinquished By:	Date/Time:	Received By:	Date/Time:
Jak T Bruskewitz	11/07/01 1530	Shipped Fed Ex	
		Tracking # 827661887958	
Fed Ex	11/8/01 10:30		11/8/01 10:30

En Chem Project No:

Sample Receipt Temp: 2.1, 2.3, 3.3 C KOZ

Sample Receipt pH (Wet/Metals): Adjusted

Cooler Custody Seal: Present / Not Present

Intact / Not Intact

(Please Print Legibly)

Company Name: TN & Associates
Branch or Location: Milwaukee
Project Contact: Kate Burell
Telephone: 414-257-4200
Project Number: 2001197
Project Name: Pulzo Mine Site
Project State: IL
Sampled By (Print): John Bruskewitz

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Green Bay, WI 54302
920-469-2436
FAX 920-469-8827

525 Science Drive
Madison, WI 53711
608-232-3300
FAX: 608-233-0502

CHAIN OF CUSTODY

74250

P.O. # _____ Quote # _____

Mail Report To: Kate Burell
Company: TN & Associates
Address: 1033 N Mayfair Rd Suite 300
Milwaukee WI 53226
Invoice To: Accounts Payable
Company: TN & Associates
Address: 1033 N. Mayfair Rd
Milwaukee WI 53226
Mail Invoice To: _____

*Preservation Codes
A=None B=HCL C=H2SO4 D=HNO3 E=EnCore F=Methanol G=NaOH
H = Sodium Bisulfate Solution I = Other Zn Acetate NaOH

FILTERED? (YES/NO): N N N
PRESERVATION (CODE)*: D I A

ANALYSES REQUESTED: Hardness, Metals ✱, Sulfide, Acidity, Alkalinity, Sulfate
TOTAL # OF BOTTLES SENT

Data Package Options
(please circle if requested)
Results Only
EnChem Level III (Subject to Surcharge)
EnChem Level IV (Subject to Surcharge)

Regulatory Program: UST, RCRA, SDWA, NPDES, CERCLA

Matrix Codes: W=Water, S=Soil, A=Air, C=Charcoal, B=Biota, Sl=Sludge

LABORATORY ID (Lab Use Only)	FIELD ID	COLLECTION DATE	COLLECTION TIME	MATRIX	CLIENT COMMENTS	LAB COMMENTS (Lab Use Only)
913932-015	SC 1015	11/07/01	0940	W	3	
-016	SC 1020	11/07/01	1050	W	3	
-017	MW-10	11/07/01	1505	W	3	
-018	EA-1	11/07/01	1515	W	3	
-019						WT 1006 Rec'd 11/8/01

✱ Metals AL, As, Ba, Ca, Cd, Cr, Cu, Fe, Pb, Mg, Mn, Sb, Ag, Zn

Rush Turnaround Time Requested (TAT) - Prelim
(Rush TAT subject to approval/surcharge)
Date Needed: _____
Transmit Prelim Rush Results by (circle):
Phone Fax E-Mail
Phone #: _____
Fax #: _____
E-Mail Address: _____

Samples on HOLD are subject to special pricing and release of liability

Relinquished By:	Date/Time:	Received By:	Date/Time:
John Bruskewitz	11/07/01 530	Shipped Via Fed Ex	
Relinquished By:	Date/Time:	Received By: Tracking # 827661841958	Date/Time:
Fed Ex	11/8/01 10:30		11/8/01 10:30
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:

En Chem Project No.:
Sample Receipt Temp: 2° 2.3° 3° C R
Sample Receipt pH (Wet/Metals): Adjusted
Cooler Custody Seal: Present / Not Present
Intact / Not Intact

HARDNESS RESULTS

5102 LaRoche Avenue • Savannah, GA 31404 • Tel: 912 354 7858 • Fax: 912 352 0165 • www.stl-inc.com

STL Savannah

LOG NO: S1-17710
Received: 29 NOV 01
Reported: 10 DEC 01

Ms. Lynn Dieffenbach
Enchem, Inc.
525 Science Drive
Madison, WI 53711

Cl Project No: 913932

Sampled By: Client
Code: 174511210

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE/ TIME SAMPLED
17710-1	913932-001	11-06-01/10:29
17710-2	913932-002	11-06-01/10:54
17710-3	913932-003	11-06-01/13:35
17710-4	913932-004	11-06-01/14:14
17710-5	913932-005	11-06-01/16:05

PARAMETER	17710-1	17710-2	17710-3	17710-4	17710-5
Hardness as CaCO3 (130.2), mg/l	430	140	680	570	540
Dilution Factor	5	1	5	5	5
Prep Date	12.05.01	12.05.01	12.05.01	12.05.01	12.05.01
Analysis Date	12.05.01	12.05.01	12.05.01	12.05.01	12.05.01
Batch ID	1205A	1205A	1205A	1205A	1205A

5102 LaRoche Avenue • Savannah, GA 31404 • Tel: 912 354 7858 • Fax: 912 352 0165 • www.stl-inc.com

STL Savannah

LOG NO: S1-17710
Received: 29 NOV 01
Reported: 10 DEC 01

Ms. Lynn Dieffenbach
Enchem, Inc.
525 Science Drive
Madison, WI 53711

Cl Project No: 913932

Sampled By: Client
Code: 174511210

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE/ TIME SAMPLED
17710-6	913932-006	11-06-01/16:28
17710-7	913932-007	11-07-01/14:25
17710-8	913932-008	11-07-01/14:22
17710-9	913932-009	11-07-01/13:33
17710-10	913932-012	11-07-01/08:45

PARAMETER	17710-6	17710-7	17710-8	17710-9	17710-10
Hardness as CaCO3 (130.2), mg/l	1000	190	190	240	370
Dilution Factor	5	1	1	1	1
Prep Date	12.05.01	12.05.01	12.05.01	12.05.01	12.05.01
Analysis Date	12.05.01	12.05.01	12.05.01	12.05.01	12.05.01
Batch ID	1205A	1205A	1205A	1205A	1205A

SEVERN TRENT SERVICES
STL Savannah
5102 LaRoche Avenue • Savannah, GA 31404 • Tel: 912 354 7858 • Fax: 912 352 0165 • www.stlinc.com

LOG NO: S1-17710
Received: 29 NOV 01
Reported: 10 DEC 01

Ms. Lynn Dieffenbach
Enchem, Inc.
525 Science Drive
Madison, WI 53711

Cl Project No: 913932

Sampled By: Client
Code: 174511210

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE/ TIME SAMPLED
17710-11	913932-013	11-07-01/10:10
17710-12	913932-014	11-07-01/12:35
17710-13	913932-015	11-07-01/09:50
17710-14	913932-016	11-07-01/10:50
17710-15	913932-017	11-07-01/15:05

PARAMETER	17710-11	17710-12	17710-13	17710-14	17710-15
Hardness as CaCO3 (130.2), mg/l	180	180	220	180	970
Dilution Factor	1	1	1	1	5
Prep Date	12.05.01	12.05.01	12.05.01	12.05.01	12.05.01
Analysis Date	12.05.01	12.05.01	12.05.01	12.05.01	12.05.01
Batch ID	1205A	1205A	1205A	1205A	1205A

5102 LaRoche Avenue • Savannah, GA 31404 • Tel: 912 354 7858 • Fax: 912 352 0165 • www.stl-inc.com

STL Savannah

LOG NO: S1-17710
Received: 29 NOV 01
Reported: 10 DEC 01

Ms. Lynn Dieffenbach
Enchem, Inc.
525 Science Drive
Madison, WI 53711

Cl Project No: 913932

Sampled By: Client
Code: 174511210

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE/ TIME SAMPLED
17710-16	913932-018	11-07-01/15:15
17710-17	913932-019	11-07-01/14:50

PARAMETER	17710-16	17710-17
Hardness as CaCO3 (130.2), mg/l	<10	550
Dilution Factor	1	5
Prep Date	12.05.01	12.05.01
Analysis Date	12.05.01	12.05.01
Batch ID	1205A	1205A

SEVERN TRENT SERVICES
STL Savannah
5102 LaRoche Avenue • Savannah, GA 31404 • Tel: 912 354 7858 • Fax: 912 352 0165 • www.stl-inc.com

LOG NO: S1-17710
Received: 29 NOV 01
Reported: 10 DEC 01

Ms. Lynn Dieffenbach
Enchem, Inc.
525 Science Drive
Madison, WI 53711

Cl Project No: 913932

Sampled By: Client
Code: 174511210

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , QC REPORT FOR LIQUID SAMPLES	DATE/ TIME SAMPLED
17710-18	Method Blank	
17710-19	Lab Control Standard % Recovery	

PARAMETER	17710-18	17710-19			
Hardness as CaCO3 (130.2), mg/l	<10	98 %			
Dilution Factor	1	1			
Prep Date	12.05.01	12.05.01			
Analysis Date	12.05.01	12.05.01			
Batch ID	1205A	1205A			

These test results meet all the requirements of NELAC. All questions regarding this test report should be directed to the STL Project Manager who signed this test report.

Bernard Kirkland, Project Manager

Final Page Of Report

(Please Print Legibly)

Company Name: STL Savannah

Branch or Location: 5102 LaRoche Ave. Savannah, GA 31404

Project Contact: Bernard Kirkland

Telephone: 912-354-7858

Project Number: 913932

Project Name: -

Project State: IL

Sampled By (Print): -

Data Package Options
(please circle if requested)
Results Only
EnChem Level III (Subject to Surcharge)
EnChem Level IV (Subject to Surcharge)

Regulatory Program: UST, RCRA, SDWA, NPDES, CERCLA

Matrix Codes: W=Water, S=Soil, A=Air, C=Charcoal, B=Biota, Sl=Sludge

EN CHEM INC.

1241 Bellevue St., Suite 9
Green Bay, WI 54302
920-469-2436
FAX 920-469-8827

525 Science Drive
Madison, WI 53711
608-232-3300
FAX: 608-233-0502

CHAIN OF CUSTODY

73367

Page 1 of 2

P.O. # _____ Quote # _____

Mail Report To: Lynn Dieffenbach

Company: EnChem

Address: 525 Sciena Dr. Madison, WI 53711

Invoice To: same

Company: _____

Address: _____

Mail Invoice To: Lynn Dieffenbach 608-232-3396

*Preservation Codes
A=None B=HCL C=H2SO4 D=HNO3 E=EnCore F=Methanol G=NaOH
H = Sodium Bisulfate Solution I = Other

FILTERED? (YES/NO)
PRESERVATION (CODE)*

ANALYSES REQUESTED: Hardness 130.1

TOTAL # OF BOTTLES SENT

LABORATORY ID (Lab Use Only)	FIELD ID	COLLECTION DATE	COLLECTION TIME	MATRIX	Hardness 130.1							TOTAL # OF BOTTLES SENT	CLIENT COMMENTS	LAB COMMENTS (Lab Use Only)
	913932-001	11/6/01	1029	W	X							1	SW-1001	
	-002		1054										PD-1002	
	-003		1335										WT-1003	
	-004		1414										WT-1004	
	-005		1605										WT-1009	
	-006		1628										PD-1010	
	-007	11/7/01	1425										PD-10229	
	-008		1422										PD-1022	
	-009		1333										SC-1025	
	-012		0845										PD-1012	
	-013		1010										SC-1017	
	-014		1235										SC-1023	

51-17710

Rush Turnaround Time Requested (TAT) - Prelim
(Rush TAT subject to approval/surcharge)
Date Needed: 12/12/01
Transmit Prelim Rush Results by (circle):
Phone Fax E-Mail
Phone #: _____
Fax #: _____
E-Mail Address: _____

Samples on HOLD are subject to special pricing and release of liability

Relinquished By:	Date/Time:	Received By:	Date/Time:
[signature]	11/28/01	[signature]	11/29/01 10Am

En Chem Project No.

Sample Receipt Temp.

Sample Receipt pH (Wet/Metals)

Cooler Custody Seal
Present / Not Present
Intact / Not Intact

(Please Print Legibly)

Company Name: STL Savannah

Branch or Location: 5102 LaRochu Ave. Savannah, GA 31404

Project Contact: Bernard Kirkland

Telephone: 912-354-7858

Project Number: 913932

Project Name: —

Project State: IL

Sampled By (Print): —

EN CHEM INC.

1241 Bellevue St., Suite 9
Green Bay, WI 54302
920-469-2436
FAX 920-469-8827

525 Science Drive
Madison, WI 53711
608-232-3300
FAX: 608-233-0502

CHAIN OF CUSTODY

73368

Page 2 of 2

*Preservation Codes
A=None B=HCL C=H2SO4 D=HNO3 E=EnCore F=Methanol G=NaOH
H = Sodium Bisulfate Solution I = Other

P.O. # _____ Quote # _____

Mail Report To: Lynn Dieffenbach

Company: EnChem

Address: 525 Science Dr.
Madison, WI 53711

Invoice To: Same

Company: _____

Address: _____

Mail Invoice To: Lynn Dieffenbach 608.232.330

Data Package Options
(please circle if requested)
Results Only
~~EnChem Level III~~ (Subject to Surcharge)
EnChem Level IV (Subject to Surcharge)

Regulatory Program
UST
RCRA
SDWA
NPDES
CERCLA

Matrix Codes
W=Water
S=Soil
A=Air
C=Charcoal
B=Biota
Sl=Sludge

LABORATORY ID (Lab Use Only)	FIELD ID	COLLECTION DATE	COLLECTION TIME	MATRIX	FILTERED? (YES/NO)	PRESERVATION (CODE)*	ANALYSES REQUESTED: Hardness 130.1	TOTAL # OF BOTTLES SENT	CLIENT COMMENTS	LAB COMMENTS (Lab Use Only)
	913932-015	11/7/01	0950	W	N	A	X	1	SC 1015 ✓	
	-016	"	1050	"	"	"	"	"	SC 1020 ✓	
	-017	"	1505	"	"	"	"	"	MW-10 ✓	
	-018	"	1515	"	"	"	"	"	ER-1 ✓	
	-019	11/6/01	1450	"	"	"	"	"	WT 1006 ✓	

S1-17710

Rush Turnaround Time Requested (TAT) - Prelim
(Rush TAT subject to approval/surcharge)
Date Needed: 12/12/01
Transmit Prelim Rush Results by (circle):
Phone Fax E-Mail
Phone #: _____
Fax #: _____
E-Mail Address: _____

Samples on HOLD are subject to special pricing and release of liability

Relinquished By:	Date/Time:	Received By:	Date/Time:
[signature]	11/28/01	KC	11/29/01 10:30
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:

En Chem Project No.

Sample Receipt Temp.

Sample Receipt pH (Wet/Metals)

Cooler Custody Seal
Present / Not Present

Intact / Not Intact

APPENDIX D
Water Supply Wells Information

Appendix D. Private Water Supply Well Information

Palzo Mine Site - Shawnee National Forest, IL
PA/SI Report - January 2002

Township	Range	Section	Well ID	Plot	Depth	Record Type	Well Use	Well Type	Aquifer Type	Driller	Date Drilled	Static Level	Pumping Level	Pumping GPM	Pumping Hours	ISGS No.
09S	03E	25	207444		24	RG	DO	BD	-		1934					
09S	03E	25	207445		28	RG	DO	BD	-		1934					
09S	03E	26	207446		31	RG	DO	BD	-		1934					
09S	03E	26	207447		21	RG	DO	BD	-		1934					
09S	03E	35	207461		29	RG	DO	BD	-		1934					
09S	03E	35	207462		14	RG	DO	BD	-		1934					
09S	03E	35	207469	5C	30	RG	DO	BD	UN	KOHNEN	9/17/1974					
09S	03E	36	207463		23	RG	DO	BD	-		1934					
09S	04E	27	207492		14	RG	DO	BD	-		1934					
09S	04E	29	207493	7D	80	RGC	DO	BD	-		07/ /1933					
09S	05E	31	274440	7A	14	OG	DO	DL	BR	PARKS	1910	5				
10S	03E	11	207687		18	RG	DO	BD	-		1934					
10S	03E	13	207688		32	RG	DO	BD	-		1934					
10S	03E	23	207695		30	RG	DO	BD	-		1934					
10S	03E	23	207709	6A	110	RG	DO	-	BR	GEER	4/21/1970	24				
10S	03E	25	207696		30	C	DO	BD	BR		8/16/1907					
10S	03E	25	207697		35	RG	DO	BD	-		1934					
10S	03E	26	207698		24	RG	DO	BD	-		1934					
10S	03E	35	207705		15	RG	DO	BD	-		1934					
10S	03E	35	207716	1H	210	RG	DO	-	BR	BEANLAND	9/29/1970	105				
10S	03E	35	207717	8E	100	RG	DO	-	BR	GEER	4/10/1980	25				
10S	03E	36	207706		180	RG	DO	-	-		1934					
10S	04E	10	207718		25	RG	DO	BD	-		1934					
10S	04E	15	207719		14	RG	DO	BD	-		1934					
10S	04E	15	207725	7B	70	RG	DO	-	BR	RICHEY	6/2/1975	4				
10S	04E	16	207720		14	RG	DO	BD	-		1934					
10S	04E	18	207726	4G	135	RG	DO	-	BR	RICHEY	11/18/1970	70				
10S	04E	20	207721		30	RG	DO	BD	-		1934					
10S	04E	20	207727	8A	100	RG	DO	-	BR	GEER	8/19/1970	33				
10S	04E	21	207728	1B	75	RG	DO	-	BR	GEER	2/14/1989	25				
10S	04E	26	207729	1H	100	RG	DO	-	BR	RICHEY	12/29/1973	14				
10S	04E	26	207736	7G	14	C	DO	-	-		1980					
10S	04E	26	207737	7F	21	C	DO	-	-		1980					
10S	04E	26	207738	8G	14		DO	-	-		1980					
10S	04E	29	207722		30	RG	DO	BD	-		1934					
10S	04E	30	207730	1D	26	RGX	DO	-	BR	KOHNEN	12/12/1975					
10S	04E	31	207731	6H	160	RG	DO	-	BR	GEER	10/6/1972	50				
10S	04E	32	207723		24	RG	DO	BD	-		1934					
10S	04E	33	207732		77	RG	DO	-	BR	RICHEY	6/16/1967					
10S	04E	33	207733	1A	215	RG	DO	-	BR	GEER	3/15/1974	75				
10S	04E	35	207734	3F	208	RG	DO	-	BR	BEANLAND	5/7/1974	20				
10S	04E	35	207735	3H	165	RG	DO	-	BR	BEANLAND	7/26/1973	10				
10S	04E	36	260597	8B	120	RG	DO	DL	BR	KEEN	9/20/1991	10	105	10	4	
10S	04E	36	297312	7B	60	RG	DO	DL	BR	BRADLEY KEEN	5/22/1997		37	100	4	
10S	05E	6	274608	6H	27	OG	DO	DL	BR	PARKS	1920	5				
10S	05E	18	274624	1B	500	O	DO	DL	-	MITCHELL	3/16/1905	20				
10S	05E	19	300316	8H	120	RG	DO	DL	BR	BRADLEY KEEN	12/17/1997	34	108	0.5	4	26
10S	05E	30	274638	8B	300	OG	DO	DL	BR	GASKINS	1914	30				
10S	05E	30	274639	3G	30	OG	DO	DL	BR	OSHEL	1909	20				
10S	05E	31	274641	3C	26	OG	DO	DL	BR	TABORN	1920	21				
11S	04E	1	276288	2G	6	O	DO	SG	-		1934					
11S	04E	2	276289	4H	14	O	DO	DU	-		1889	7				
11S	04E	3	276290	7H	3	O	DO	SG	-		1934					
11S	04E	3	276291	7A	15	U	DO	SG	-		1934					
11S	04E	4	276292	7C	5	O	DO	SG	-		1934					
11S	04E	4	276293		14	O	DO	DU	-		1894	10				
11S	04E	4	276359	8D	71	RG	DO	DL	DH	RICHEY	6/4/1969					
11S	04E	5	276294	4E	13	O	DO	DU	-		1884	8				
11S	04E	5	276295	5B	16	O	DO	DU	-		1884	9				
11S	04E	6	276296	1D	18	O	DO	DU	-		1884	10				
11S	04E	6	276297	8G	15	O	DO	DU	-		1889	12				

Source: ISWS Private Well Database. Internet address: www.sws.uiuc.edu/data/gwdb.info/asp Accessed: October 30, 2001.

Record Type
- C = Chemical Analyses
- G = Geologic Bore Hole
- O = Other type not listed
- R = Well Construction Report
- X = Indicates something unusual which is reported as a "coment"

Well Use
- DO = Domestic

Well Type
- BD = Bored
- DL = Drilled
- DU = Dug (being phased out)
- SG = Spring
- - = Unknown

Aquifer Type
- BR = Bedrock
- DH = Dry Hole
- UN = Unconsolidated
- - = Unknown

APPENDIX E
EPA Preliminary Assessment Form

OMB Approval Number: 2050-0095
Approved for Use Through: 1/92

EPA Potential Hazardous Waste Site Preliminary Assessment Form

Identification

State: | CERCLIS Number:

CERCLIS Discovery Date:

1. General Site Information

Name: Palzo Mine Site

Street Address: Highway 12/Bost Orchard Road

City:

State: IL | Zip Code: 62987 | County: Williamson | Co. Code: | Cong. Dist:

Latitude: 37° 39' 00.-" Longitude: 88° 46' 00.-"

Approximate Area of Site: 312 Acres _____ Square Ft

Status of Site: ☐ Active ☐ Not Specified ☒ Inactive ☐ NA (GW plume, etc.)

2. Owner/Operator Information

Owner: United States Department of Agriculture

Street Address: Shawnee National Forest P.O. Box 37

City: Vienna

State: IL | Zip Code: 62995 | Telephone: (618) 658-2111

Type of Ownership:
☐ Private
☒ Federal Agency
Name _____
☐ State
☐ Indian
☐ County
☐ Municipal
☐ Not Specified
☐ Other _____

Operator: Stonefort Coal Company

Street Address: Stonefort Road

City: Stonefort

State: IL | Zip Code: 62987 | Telephone: ( ) NA

How Initially Identified:
☒ Citizen Complaint
☐ PA Petition
☐ State/Local Program
☐ RCRA/CERCLA Notification
☐ Federal Program
☐ Incidental
☐ Not Specified
☐ Other _____

3. Site Evaluator Information

Name of Evaluator:

Agency/Organization: TN & A Associates, Inc

Date Prepared: Site Visit 11/6/2001

Street Address: 1033 N. Mayfair Rd, Suite 200 | City: Milwaukee | State: WI

Name of EPA or State Agency Contact: Tim Buxton

Street Address: Hwy 8 West

City: Potosi | State: MO | Telephone: (573) 438-5427

4. Site Disposition (for EPA use only)

Emergency Response/Removal Assessment Recommendation:
☐ Yes
☐ No
Date: _____

CERCLIS Recommendation:
☐ Higher Priority SI
☐ Lower Priority SI
☐ NFRAP
☐ RCRA
☐ Other _____
Date: _____

Signature:

Name (typed):

Position:

EPA **Potential Hazardous Waste Site**
Preliminary Assessment Form - Page 2 of 4

CERCLIS Number:

5. General Site Characteristics

Predominant Land Uses Within 1 Mile of Site (check all that apply):
- ☐ Industrial
- ☒ Agriculture
- ☐ DOI
- ☐ Commercial
- ☒ Mining
- ☐ Other Federal Facility
- ☐ Residential
- ☐ DOD
- ☒ Forest/Fields
- ☐ DOE
- ☐ Other

Site Setting:
- ☐ Urban
- ☐ Suburban
- ☒ Rural

Years of Operation:
Beginning Year 1959
Ending Year 1961
☐ Unknown

Type of Site Operations (check all that apply):
- ☐ Manufacturing (must check subcategory)
  - ☐ Lumber and Wood Products
  - ☐ Inorganic Chemicals
  - ☐ Plastic and/or Rubber Products
  - ☐ Paints, Varnishes
  - ☐ Industrial Organic Chemicals
  - ☐ Agricultural Chemicals (e.g., pesticides, fertilizers)
  - ☐ Miscellaneous Chemical Products (e.g., adhesives, explosives, ink)
  - ☐ Primary Metals
  - ☐ Metal Coating, Plating, Engraving
  - ☐ Metal Forging, Stamping
  - ☐ Fabricated Structural Metal Products
  - ☐ Electronic Equipment
  - ☐ Other Manufacturing
- ☒ Mining
  - ☐ Metals
  - ☒ Coal
  - ☐ Oil and Gas
  - ☐ Non-metallic Minerals
- ☐ Retail
- ☐ Recycling
- ☐ Junk/Salvage Yard
- ☐ Municipal Landfill
- ☐ Other Landfill
- ☐ DOD
- ☐ DOE
- ☐ DOI
- ☐ Other Federal Facility
- ☐ RCRA
  - ☐ Treatment, Storage, or Disposal
  - ☐ Large Quantity Generator
  - ☐ Small Quantity Generator
  - ☐ Subtitle D
    - ☐ Municipal
    - ☐ Industrial
  - ☐ "Converter"
  - ☐ "Protective Filer"
  - ☐ "Non- or Late Filer"
- ☐ Not Specified
- ☐ Other

Waste Generated:
- ☒ Onsite
- ☐ Offsite
- ☐ Onsite and Offsite

Waste Deposition Authorized By:
- ☐ Present Owner
- ☒ Former Owner
- ☐ Present & Former Owner
- ☐ Unauthorized
- ☐ Unknown

Waste Accessible to the Public:
- ☒ Yes
- ☐ No

Distance to Nearest Dwelling, School, or Workplace:
100 Feet

6. Waste Characteristics Information

Source Type: (check all that apply)	Source Waste Quantity: (include units)	Tier*:
☐ Landfill		
☒ Surface Impoundment		
☐ Drums		
☐ Tanks and Non-Drum Containers		
☐ Chemical Waste Pile		
☐ Scrap Metal or Junk Pile		
☒ Tailings Pile	1.17×10^9 ft^2	A
☐ Trash Pile (open dump)		
☐ Land Treatment		
☐ Contaminated Ground Water Plume (unidentified source)		
☐ Contaminated Surface Water/Sediment (unidentified source)		
☐ Contaminated Soil		
☐ Other		
☐ No Sources		

* C = Constituent, W = Wastestream, V = Volume, A = Area

General Types of Waste (check all that apply)
- ☐ Metals
- ☐ Organics
- ☐ Inorganics
- ☐ Solvents
- ☐ Paints/Pigments
- ☐ Laboratory/Hospital Waste
- ☐ Radioactive Waste
- ☐ Construction/Demolition Waste
- ☐ Pesticides/Herbicides
- ☐ Acids/Bases
- ☐ Oily Waste
- ☐ Municipal Waste
- ☒ Mining Waste
- ☐ Explosives
- ☐ Other

Physical State of Waste as Deposited (check all that apply):
- ☒ Solid
- ☐ Sludge
- ☐ Powder
- ☐ Liquid
- ☐ Gas

EPA **Potential Hazardous Waste Site**
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CERCLIS Number:

7. Ground Water Pathway

Is Ground Water Used for Drinking Water Within 4 Miles:
- [X] Yes
- [ ] No

Type of Drinking Water Wells Within 4 Miles (check all that apply):
- [ ] Municipal
- [X] Private
- [ ] None

Is There a Suspected Release to Ground Water:
- [X] Yes
- [ ] No

Have Primary Target Drinking Water Wells Been Identified:
- [X] Yes
- [ ] No

If Yes, Enter Primary Target Population:
9 People

Depth to Shallowest Aquifer:
9 Feet

Karst Terrain/Aquifer Present:
- [ ] Yes
- [X] No

Nearest Designated Wellhead Protection Area:
- [ ] Underlies Site
- [ ] >0 - 4 Miles
- [X] None Within 4 Miles

List Secondary Target Population Served by Ground Water Withdrawn From:

0 - ¼ Mile	
> ¼ - ½ Mile	
> ½ - 1 Mile	
> 1 - 2 Miles	
> 2 - 3 Miles	
> 3 - 4 Miles	
Total Within 4 Miles	

8. Surface Water Pathway

Type of Surface Water Draining Site and 15 Miles Downstream (check all that apply):
- [X] Stream
- [X] River
- [ ] Pond
- [ ] Lake
- [ ] Bay
- [ ] Ocean
- [ ] Other _____

Shortest Overland Distance From Any Source to Surface Water:
0 Feet
_____ Miles

Is There a Suspected Release to Surface Water:
- [X] Yes
- [ ] No

Site is Located in:
- [ ] Annual - 10 yr Floodplain
- [X] >10 yr - 100 yr Floodplain
- [ ] >100 yr - 500 yr Floodplain
- [ ] >500 yr Floodplain

Drinking Water Intakes Located Along the Surface Water Migration Path:
- [ ] Yes
- [X] No

Have Primary Target Drinking Water Intakes Been Identified:
- [ ] Yes
- [X] No

If Yes, Enter Population Served by Primary Target Intakes:
0 People

List All Secondary Target Drinking Water Intakes:

Name	Water Body	Flow (cfs)	Population Served

Total within 15 Miles _____

Fisheries Located Along the Surface Water Migration Path:
- [ ] Yes
- [X] No

Have Primary Target Fisheries Been Identified:
- [ ] Yes
- [X] No

List All Secondary Target Fisheries:

Water Body/Fishery Name	Flow (cfs)

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8. Surface Water Pathway (continued)

Wetlands Located Along the Surface Water Migration Path:
☒ Yes
☐ No

Have Primary Target Wetlands Been Identified:
☒ Yes
☐ No

List Secondary Target Wetlands:

Water Body	Flow (cfs)	Frontage Miles
Sugar Creek	10-100	0
South Fork	161	0.25mi

Other Sensitive Environments Located Along the Surface Water Migration Path:
☐ Yes
☒ No

Have Primary Target Sensitive Environments Been Identified:
☐ Yes
☒ No

List Secondary Target Sensitive Environments:

Water Body	Flow (cfs)	Sensitive Environment Type

9. Soil Exposure Pathway

Are People Occupying Residences or Attending School or Daycare on or Within 200 Feet of Areas of Known or Suspected Contamination:
☒ Yes
☐ No

If Yes, Enter Total Resident Population:
9 People

Number of Workers Onsite:
☐ None
☒ 1 - 100
☐ 101 - 1,000
☐ >1,000

Have Terrestrial Sensitive Environments Been Identified on or Within 200 Feet of Areas of Known or Suspected Contamination:
☐ Yes
☒ No

If Yes, List Each Terrestrial Sensitive Environment:

10. Air Pathway

Is There a Suspected Release to Air:
☐ Yes
☒ No

Enter Total Population on or Within:

Onsite	0
0 - ¼ Mile	9
> ¼ - ½ Mile	
> ½ - 1 Mile	63
> 1 - 2 Miles	162
> 2 - 3 Miles	221
> 3 - 4 Miles	720
Total Within 4 Miles	1275

Wetlands Located Within 4 Miles of the Site:
☒ Yes
☐ No

Other Sensitive Environments Located Within 4 Miles of the Site:
☐ Yes
☒ No

List All Sensitive Environments Within ½ Mile of the Site:

Distance	Sensitive Environment Type/Wetlands Area (acres)
Onsite	NONE
0 - ¼ Mile	NONE
> ¼ - ½ Mile	Wetland ≃ 3.25 mi E/NE

APPENDIX F

APPENDIX F
Species Lists

Table F-1: Inventory of Dominant Vegetation for the Palzo Mine Site in Shawnee National Forest

Scientific Name	Common Name
Acer platanoides	Norway maple
Acer saccharinum	Silver maple
Acer saccharum	Sugar maple
Achillea millefolium	Yarrow
Actea sp.	Baneberry
Andropogon elliottii	Elliott's broom sedge
Andropogon virginicus	Broom sedge
Ascelpias syriaca	Common milkweed
Asimina triloba	Pawpaw
Asplenium platyneuron	Ebony speenwort
Aster novae-angliae	New England aster
Aster spp.	Aster species
Betula nigra	River birch
Bidens sp.	Beggar-tick
Botrychium dissectum	Cut-leaved grape fern
Bromus inermis	Smooth brome-grass
Campsis radicans	Tumpet creeper
Carex spp.	Sedge species
Carpinus caroliniana	American hornbeam, Blue-beech
Carya ovata	Shagbark hickory
Catalpa speciosa	Northern catalpa
Celtis occidentalis	Northern hackberry
Chasmanthium latifloium	Wild oats
Cirsium arvense	Canada thistle
Cirsium vulgare	Bull thistle
Cladonia cristatella	British soldiers (lichen)
Cornus alternifolia	Alternate-leaf dogwood
Cornus amomum	Silky dogwood
Daucus carota	Queen Anne's Lace
Digitaria seontina	Dwarf crab-grass
Elaegnus umbellata	Autumn olive
Elymus viginicus	Virginia wild rye
Eupatorium rugosa	White snakeroot
Euthamia graminifolia	Common flat-topped goldenrod
Festuca arundinacea	Tall fescue
Festuca sp.	Fescue
Fraxinus americana	White ash
Geum canadense	Avens
Gnapthalium obtusifolium	Cudweed
Juglans nigra	Black walnut
Juniperus virginiana	Eastern red cedar
Lespedeza cuneata	Chinese lespedeza
Liquidambar styraciflua	Sweetgum

Table F-1: continued

Liriodendron tulipifera	Tuliptree, Yellow-poplar
Lonicera japonica	Japanese honeysuckle
Lycopus americanus	Water horehound
Magnolia sp.	Magnolia
Medicago sativa	Alfalfa
Melilotus alba	White sweet clover
Melilotus officinalis	Yellow sweet clover
Oenothera biennis	Evening primrose
Panicum uliginosum	Panic grass
Panicum virgatum	Switchgrass
Phalaris arundinacea	Reed canary grass
Phragmites sp.	Giant reed grass
Physalis virginiana	Virginia ground cherry
Phytolacca americana	Pokeweed
Pinus palustris	Longleaf pine
Pinus strobus	White pine
Pinus taeda	Loblolly pine
Pinus virginana	Virginia pine
Plantanus occidentalis	American sycamore
Polygonum lapthifolium	Pinkweed
Populus deltoides	Eastern cottonwood
Pycnanthemum tenuifolium	Mountain mint
Quercus alba	White oak
Quercus bicolor	Swamp white oak
Quercus imbricaria	Shingle oak
Quercus macrocarpa	Burr oak, Mossycup oak
Quercus muhlenbergii	Chinkapin oak, Yellow oak
Quercus prinus	Chestnut oak, Rock oak
Quercus rubra	Red oak
Rhus copallinum	Shining sumac
Ribes sp.	Currant
Robinia pseudoaccia	Black locust
Salix spp.	Willow
Sassafras albidum	Sassafras
Setaria faberi	Nodding, Giant foxtail
Smilax glauca	Cat brier
Solidago canadensis	Canada goldenrod
Tridens flavus	Purpletop
Ulmus alata	Winged elm
Ulmus rubra	Slippery, red elm
Zanthoxylum americnum	Prickly ash

Table F-2: Federal Listed, State Listed, and Regional Forester Sensitive Flora Species of the Shawnee National Forest: Palzo Mine Site Habitat Assessment

Common Name	Latin Name	Status*	Community Types	Suitable Habitat Present	Reason for Exclusion	Potential to Inhabit Area With no AMD and Restoration
Roundstem foxglove	*Agalinis (=Tomanthera) gattingeri*	RFSS	Sterile, wooded slopes and ridges, forests and barrens	Yes		Yes; range includes Williamson and surrounding counties
False foxglove	*Agalinis (= Tomanthera) skinneriana*	RFSS, ST	Calcareous, sandy prairies, dry prairies, open woods, and barrens, especially with sandy soils	No	Soils extremely acidic	Yes; range includes adjacent Saline County
Smooth false indigo	*Amorpha nitens*	RFSS, SE	Swamps, thickets and along streams	Yes		Yes; range includes adjacent Pope county
Lake Cress	*Armoracia aquatica (=A. lacustris)*	RFSS	Quiet waters and along muddy shores, especially in shallow, calcareous water	No	Water is acidic	Yes; range includes adjacent Pope, Union, Jackson and Franklin Counties
Price's groundnut (Price's potato-bean)	*Apios priceana*	T, ST	Rocky, open, mixed-oak forests, forest edges and clearings on river bottoms and ravines. Well-drained loams on old alluvium or over calcareous boulders.	Yes		No; extirpated from Illinois
Mead's milkweed	*Asclepias meadii*	T, SE	Dry mesic to mesic prairie, igneous glades, chertlime glades, dry prairie, unplowed bluestem prairie	Yes		Unlikely; only 2 extant populations in Illinois. Range includes adjacent Saline County
Bradley's spleenwort	*Asplenium bradleyi*	RFSS, SE	Sandstone cliffs and rocks on acid soil, exposed, barren sites with full sun.	Yes		Yes; range includes adjacent Jackson and Union Counties
Black-stem Spleenwort	*Asplenium resiliens*	RFSS, SE	Crevices of calcareous rocks in circumneutral soil	No	Soils extremely acidic	Unlikely; however, range includes adjacent Jackson and Union Counties
Smooth blue aster	*Aster laevis var. concinnus*	RFSS	Often mesic prairies or dry, open area, sometimes in shaded or partially shaded clay banks and disturbed areas	Yes		Yes; suitable habitat if colonizing population is present
Twining bartonia, Screwstem	*Bartonia paniculata*	RFSS, SE	Wet, peaty or sandy swamps, bogs,	No	Lack of habitat	Unlikely; however,

Table F-2: Continued

Common Name	Latin Name	Status*	Community Types	Suitable Habitat Present	Reason for Exclusion	Potential to Inhabit Area With no AMD and Restoration
			and wet meadows			range includes adjacent Pope County
Nottoway brome grass	*Bromus nottowayanus*	RFSS	Rich, loamy soils in bottomland forests along streams and rivers; occasionally mesic forests	No	Lack of habitat	Unlikely; however, range includes eastern U.S.
American barberry	*Berberis canadensis*	RFSS, SE	Rocky woods	Yes		Yes; range includes adjacent Jackson County
Blue hearts	*Buchnera Americana*	RFSS	Sandy or gravelly soils of upland woods or prairies	Yes		Yes; range includes Pope County
Ofer hollow reedgrass	*Calamagrostis porteri* spp. *insperata*	RFSS, SE	Dry, upland areas in sun or partial shade	Yes	Range does not include area	No; Range does not include Illinois
Fibrous root sedge	*Carex communis*	RFSS, ST	Upland woods on dry or moist soil	Yes	Range does not include area	No; range does not include southern Illinois
Epiphytic sedge	*Carex decomposita*	RFSS, SE	Swamps, wet woods, wooded floodplains, often dense shade	Yes		Yes; range includes adjacent Johnson and Union Counties
Large sedge	*Carex gigantea*	RFSS, SE	Swamps and wet woods	Yes		Yes; range includes adjacent Jackson, Johnson and Union Counties
Meadow sedge	*Carex granularis var. haleana*	RFSS	Wet meadows and swales, usually in calcium rich substrates	No	Lack of habitat; acidic soils	Yes; range includes adjacent Jackson, Union, Johnson and Pope Counties
False hop sedge	*Carex lupuliformis*	RFSS	Wet or swampy woods with shade or partial shade, often calcareous or neutral substrate	No	Lack of habitat; acidic soils	Yes; range includes adjacent Jackson, Johnson, Pope, Saline and Union Counties
Sharpscale sedge	*Carex oxylepis* var. *pubescens*	RFSS, ST	Rich, moist or wet woods	No	Lack of quality habitat	Yes; range includes southern Illinois
Social sedge	*Carex socialis*	RFSS	Low, woody habitats along coastal plain and interior low plateaus	Yes		Yes; range includes adjacent Jackson and Johnson Counties

Table F-2: Continued

Common Name	Latin Name	Status*	Community Types	Suitable Habitat Present	Reason for Exclusion	Potential to Inhabit Area With no AMD and Restoration
Blazing star	*Chamaelirium luteum*	RFSS	Moist woods and bogs	No	Lack of habitat	Yes; range includes adjacent Pope County
Rose turtlehead	*Chelone obliqua* var. *speciosa*	RFSS	Wet woods	Yes		Yes; range includes adjacent Jackson, Johnson, Pope, and Union Counties
Black cohosh	*Cimicifuga rubifolia*	RFSS, SE	Cool, moist woods	Yes	Range does not include area	No; range does not include southern tip of Illinois
Yellowwood	*Cladrastis kentuckea (=lutea)*	RFSS, SE	Rich woods	No	Lack of habitat and colonizing population	No; no known local populations
Hale's corydalis	*Corydalis halei (=micrantha* var. *australis)*	RFSS, SE	Moist, sandy soil	Yes	Range does not include site	No; range does not include Shawnee NF
Hawthorn	*Crataegus fecunda*	RFSS	Pastures and disturbed wooded areas	Yes		Yes; range includes Williamson and surrounding counties
Large yellow lady's slipper	*Cypripedium pubescens (=parviflorum* var. *pubescens)*	RFSS, SE	Bogs and dry to moist woods	Yes		Yes; range includes Williamson and surrounding counties
Panic grass	*Dichanthelium (=Panicum) joorii*	RFSS	Moist soil in woods and thickets	Yes		Yes; range includes adjacent Jackson, Johnson, Pope and Union Counties
Ravenel's switchgrass	*Dichanthelium (=Panicum) ravenelii*	RFSS	Dry woods	Yes		Yes; range includes adjacent Pope and Union Counties
Yadkin's panic grass	*Dichanthelium yadkinense*	RFSS	Moist or wet woods	Yes		Yes; range includes Williamson and adjacent Jackson, Johnson, Pope, Saline, and Union Counties
French's shootingstar	*Dodecantheon frenchii*	RFSS	Moist woods, meadows, prairies, shaded cliffs, and sandstone bluffs	Yes		Yes; range includes Williamson and adjacent Jackson, Johnson, Pope, Saline and Union Counties

Table F-2: Continued

Common Name	Latin Name	Status*	Community Types	Suitable Habitat Present	Reason for Exclusion	Potential to Inhabit Area With no AMD and Restoration
Wavy-leaf purple-coneflower	*Echinacea simulata*	RFSS	Woods and prairies	Yes		Yes range includes adjacent Saline County
Wolf spikerush	*Eleocharis wolfii*	RFSS	Marshes	No		Yes; range includes adjacent Saline County
Cluster fescue	*Festuca paradoxa*	RFSS	Moist or wet, open woods and prairies	Yes		Yes; range includes Williamson and adjacent Jackson, Johnson, Pope and Union Counties
Yellow gentian	*Gentiana alba*	RFSS	Moist prairies, open woods, savannahs, grassy meadows, and damp woods	Yes		Yes; range includes adjacent Jackson and Pope Counties
Silphium sunflower	*Helianthus silphioides*	RFSS	Open woods and thickets	Yes	Range does not include area	No; range does not include Williamson or adjacent counties
Kidneyleaf mud-plantain	*Heteranthera reniformis*	RFSS, SE	Muddy shores, shallow water and wetlands	Yes		Yes; range includes adjacent Pope and Jackson Counties
Crested coralroot	*Hexalectris spicata*	RFSS, SE	Calcareous open woods and prairie openings, dry, usually rocky woods of limestone substrate	No	Extremely acidic soils; Habitat not present	Unlikely; however, range includes adjacent Jackson and Pope Counties.
Featherfoil	*Hottonia inflata*	RFSS	Quiet, shallow waters or wet soil, primarily on coastal plains	Yes		Yes; range includes adjacent Jackson, Johnson, Pope and Union counties
Small whorled pogonia	*Isotria medeoloides*	E, SE	Dry, rocky, wooded slopes with mesic, acid soils crisscrossed by vernal streams. Young forests and maturing stands of mixed hardwoods or mixed coniferous and deciduous trees.	Yes	Site is not within species range	No; known to occur on only one site in Illinois in Randolph County
Large whorled pogonia	*Isotria verticillata*	RFSS, SE	Woods with acid soils	Yes		Possible; not known to occur in project area

Table F-2: Continued

Common Name	Latin Name	Status*	Community Types	Suitable Habitat Present	Reason for Exclusion	Potential to Inhabit Area With no AMD and Restoration
Butternut	*Juglans cinerea*	RFSS	Rich, loamy soils of stream banks, on low rocky hills, in mesic forests and floodplain forests. Prefers calcareous substrates.	Yes		Yes; species within range
Grass-leaved rush	*Juncus marginatus* var. *marginatus*	RFSS	Marshes, low prairies, wet meadows, and sandy clearings; sterile, sandy soils where the water table has been artificially intercepted.	Yes		Yes; range includes Williamson, Jackson, Pope, Johnson, Franklin, and Saline Counties
Superb lily, Turk's cap lily	*Lilium superbum*	RFSS	Wet meadows and low areas	Yes		Yes; range includes nearby Jackson and Pope Counties
American gromwell	*Lithospermum latifolium*	RFSS	Dry forests, thickets, and wooded slopes	Yes		Yes; range includes Jackson, Johnson, Union and Pope Counties
Red honeysuckle	*Lonicera dioica* var. *glaucescens*	RFSS, SE	Moist woods, thickets and calcium rich woods; occasionally found on dunes or in swamps	Yes		Yes; range includes adjacent Jackson County
Yellow honeysuckle	*Lonicera flava*	RFSS, SE	Rocky woods and thickets	Yes		Possible; suitable habitat if colonizing population exists
Fraser's loosestrife	*Lysimachia fraseri*	RFSS, SE	Gravel bars and shrub islands in streams; sunny, rocky slopes and roadsides	Yes		Yes; range includes most of southern Illinois
Hair grass	*Muhlenbergia glabriflorus*	RFSS	Shady low areas with heavy clay; in association with *Quercus palustris* in wooded areas with soils of hard, white clays	Yes		Possible; suitable habitat if colonizing population exists
Illinois wood sorrel	*Oxalis illinoensis*	RFSS, SE	Moist forests on calcareous substrates; populations centered on the Shawnee Hills	No	Lack of habitat; extremely acidic soils,	Yes; project area located within Shawnee Hills region
American ginseng	*Panax quinquefolius*	RFSS	Rich, moist forests on north-facing slopes	Yes		Yes; could be found along Sugar Creek slopes
Bead grass	*Paspalum dissectum*	RFSS, SE	Shallow water and muddy shores of coastal plains	Yes		Yes; found in INHD for Williamson County

Table F-2: Continued

Common Name	Latin Name	Status*	Community Types	Suitable Habitat Present	Reason for Exclusion	Potential to Inhabit Area With no AMD and Restoration
Lea's bog lichen	*Phaeophyscia leana*	RFSS, SE	Moist woodland habitats	Yes		Possible; not known to occur in region
Cleft phlox	*Phlox bifida ssp. Stellaria*	RFSS	Dry, sandy soils of Oak savannahs, scrub-Oak savannahs, and on rocky ledges.	Yes		Possible; range includes adjacent Jackson, Johnson, and Union Counties
Heart-leaved plantain	*Plantago cordata*	RFSS, SE	Found in marshes or along streams and floodplain forests, especially in gravelly, calcium-rich substrates	No	Calcium poor soils. Lack of habitat	Unlikely; however, range does include adjacent Jackson and Pope Counties.
Small green woodland orchid	*Platanthera clavellata*	RFSS, SE	Acid bogs and wet soils; moist, peaty, sand prairies, acid seeps and springs in gravelly soils	Yes		Yes; range includes nearby Pope County
Southern rein orchid	*Platanthera flava* var. *flava*	RFSS, SE	Bogs, swamps, and floodplains	Yes		Possible; suitable habitat if colonizing population exists
Grove meadow grass	*Poa alsodes*	RFSS, SE	Moist woods, beech forests, upland forest, rocky bluffs and sandstone cliffs	Yes		Yes; range includes Pope and Jackson counties
Pink milkwort	*Polygala incarnata*	RFSS, SE	Dry uplands, barrens, and prairies with sandy substrates	Yes		Yes; prevalent in Illinois including Pope County
Nodding rattlesnake-root	*Prenanthes crepidinea*	RFSS	Moist woods, thickets, prairies and shaded areas in floodplains and along streambanks.	Yes		Yes; range includes adjacent Union and Jackson Counties.
White-leaved mountain-mint	*Pycnanthemum albescens*	RFSS, SE	Dry, upland woods	Yes		Yes; range includes only one Illinois county, adjacent Union County
Torrey mountain-mint	*Pychnanthemum torrei*	RFSS, SE	Fields and open woods, thickets, dry to mesic savannahs	Yes		Yes; range includes adjacent Jackson and Pope Counties
Harvey beakrush	*Rhynchospora glomerata*	RFSS, SE	Bogs and wet, sandy areas	Yes		Yes; range includes adjacent Pope County.
Sullivant's coneflower	*Rudbeckia fulgida* var. *sullivantii*	RFSS	Upland forest, floodplain forest, moist places	Yes	Site is out of range; lack of colonizing population	No; not know to occur in Williamson or adjacent counties

Table F-2: Continued

Common Name	Latin Name	Status*	Community Types	Suitable Habitat Present	Reason for Exclusion	Potential to Inhabit Area With no AMD and Restoration
Long-beaked arrowhead	*Sagittaria longirostra*	RFSS, SE	Swamps, ponds, streams, acid gravel seeps, upland oak forests	Yes		Yes; Illinois range includes Union, and Pope Counties
Weakstalk bulrush	*Scirpus(=Schoenoplectus) purshianus*	RFSS, SE	Clean, wet, sandy substrates along shoreline and dune habitats. Grows well in acid soils	Yes		Yes; range includes adjacent Pope County
Ovate catchfly	*Silene ovata*	RFSS, SE	Forests	Yes		Possible; suitable habitat if colonizing population exists
Prairie-dock	*Silphium pinnatifidum*	RFSS	Prairies	Yes		Possible; suitable habitat if colonizing population exists
Three-leaved rosinweed	*Silphium trifoliatum*	RFSS, SE	Open woods, glades, clearings	Yes	Site is out of range; lack of colonizing population	No; not known to occur in Williamson or adjacent counties
Eastern featherbells	*Stenanthemum gramineum*	RFSS, SE	Moist woodlands and meadows often with a calcareous substrate, upland forests and mesic floodplain forest.	No	Inadequate soils, lack of habitat	Unlikely; however, range includes adjacent Jackson, Pope and Union Counties
Bigleaf snowbell	*Styrax grandifolius*	RFSS, SE	Dry to moist woods, often northern hardwoods.	Yes	Lack of colonizing population	No; Range does not include Williamson or adjacent counties
Guyandotte beauty	*Synandra hispidula*	RFSS, SE	Rich woods habitat, grows well on gentle slopes.	No	Lack of quality habitat	Unlikely; however, range includes Williamson and adjacent Jackson Counties
New York fern	*Thelypteris noveboracensis*	RFSS, SE	Mixed woods, swamp margins, upland forest, and thickets. Grows well in sand and on rocky outcrops.	Yes		Yes; range includes adjacent Pope County
Bristle-fern	*Trichomanes boschianum*	RFSS, SE	Moist, shaded sandstone overhangs and damp acid pockets in cave-like gaps	Yes		Yes; range includes adjacent Johnson and Pope Counties

Table F-2: Continued

Common Name	Latin Name	Status*	Community Types	Suitable Habitat Present	Reason for Exclusion	Potential to Inhabit Area With no AMD and Restoration
Buffalo clover	*Trifolium reflexum*	RFSS, SE	Upland woods, dry prairies, savannahs; dry to mesic rocky, open woods. Grows well on acid soils.	Yes		Yes; range includes adjacent Jackson County
Deerberry, Large cranberry	*Vaccinuim stamineum*	RFSS	Dry woods, thickets, bluffs, sandstone cliffs; grows well on rocky outcrops and acid soils	Yes		Possible; range includes adjacent Pope County
Pink valerian	*Valeriana pauciflora*	RFSS	Floodplain forests with moist, rich soils.	No	Lack of suitable high quality soils	Unlikely; however, range includes Williamson and adjacent Jackson, Johnson, Union and Pope Counties
Sand grape	*Vitis rupestris*	RFSS	Dry hills, rocks, wetlands and lake borders, gravel beds and bars along streams.	Yes		Yes; range includes adjacent Jackson and Union Counties.
Barren strawberry	*Waldsteinia fragarioides*	RFSS, SE	Dry to mesic woods, thickets, bluffs, and cliffs.	Yes		Yes; range includes adjacent Pope county, Shawnee Hills area

*E = Federally Endangered
T = Federally Threatened
SE = State Endangered
ST = State Threatened
RFSS = Regional Forester Sensitive Species

Table F-3: Federal Listed, State Listed, and Regional Forester Sensitive Fauna Species of the Shawnee National Forest: Palzo Mine Site Habitat Assessment

Common Name	Latin Name	Status*	Community Types	Suitable Habitat Present	Reason for Exclusion	Potential to Inhabit Area With No AMD and Restoration
FISH						
Least brook lamprey	*Lampetra aepyptera*	FL, ST	Clean, clear brooks with fast flowing water and sand or gravel bottoms; some areas with slow water for larval development	No	Poor water quality	Yes; found upstream in Sugar Creek by DNR and historical INHS records
Pallid shiner	*Notropis amnis*	SE	Clean lakes and small to moderately large creeks	No	Poor water quality	Unlikely; no colonizing population
Pallid sturgeon	*Scaphirhynchus albus*	E	Large, turbid, free-flowing rivers with sandy or rocky bottoms	No	Poor water quality; Sugar Creek and tributary small and turbid	Unlikely; lack of suitable habitat and no nearby colonizing population
CRUSTACEANS/ MOLLUSCS						
Indiana crayfish	*Oronectes indianensis*	RFSS, SE	Streams and rivers; rocky riffles and pools of small to medium size	No	Poor water quality	Yes; found upstream by Illinois DNR; historical INHS records in Sugar Creek
Kentucky crayfish	*Oronectes kentuckiensis*	RFSS, SE	Mud bottomed streams and rivers	No	Poor water quality	Unlikely ; no colonizing population
Crayfish spp.	*Oronectes placidus*	RFSS, SE	Rivers, streams, rocky riffles and pools	No	Poor water quality	Unlikely ; no colonizing population
Carinate pillsnail	*Stenotrema (=Euchemotrema) hubric*	RFSS	Limestone bluffs of SW Illinois and surrounding forest	Yes		Yes; suitable habitat if colonizing population present
Subtle cave amphipod	*Stybobromus subtillus*	RFSS	Caves	No	No caves in project area	Unlikely ; lack of habitat
Appalachian valley cave amphipod	*Crangonyx antennatus*	SE	Caves	No	No caves in project area	Unlikely ; lack of habitat
Packard's cave amphipod	*Crangonyx packardi*	SE	Caves	No	No caves in project area	Unlikely ; lack of habitat
Bousfield's amphipod	*Gammarus bousfield*	ST	Caves	No	No caves in project area	Unlikely ; lack of habitat
Anomalous spring amphipod	*Crangonyx amomalus*	SE	Cave springs	No	No caves in project area	Unlikely ; lack of habitat
Ebony shell	*Fusconaia ebena*	ST	Fresh, non-tidal, large, permanent rivers, lakes, and reservoirs	No	Poor water quality; lack of habitat	Unlikely ; no colonizing population and lack of

Table F-3: Continued

Common Name	Latin Name	Status	Community Types	Suitable Habitat Present	Reason for Exclusion	Potential to Inhabit Area With No AMD and Restoration
						habitat
Fat pocketbook pearly mussel	*Potamilus capax*	E, SE	Clean water with undisturbed stream bottoms made up of sand, mud or gravel (no silt)	No	Poor water quality	Unlikely ; possible if colonizing population exists
Pink mucket pearly mussel	*Lampsilis orbiculata*	E	Riverine conditions in firm rubble, swept free of silt (buried in riffle areas)	No	Poor water quality	Unlikely ; possible if colonizing population exists
Kidneyshell	*Ptychobranchus fasciolaris*	SE	Imbedded in fine sediments of mud or gravel in beds of vegetation in quiet water or lodged between boulders in swift current	No	Poor water quality	Unlikely ; possible if colonizing population exists
Orange-footed pearly mussel	*Plethobasus cooperianis*	E	Medium to large rivers with sand or gravel substrates (silt free); sedentary and not occurring in impounded sections of rivers	No	Poor water quality	Yes; only extant population exists in Ohio River Drainage
INSECTS						
Cobweb skipper	*Hesperia metea*	ST	Powerlines, clearings, woodland edges and brushy places	Yes		Yes; if some grassland habitat is undisturbed and/or native grasses are planted
AMPHIBIANS/REPTILES						
Dusky salamander	*Desmognathus fuscus*	FL, SE	Moist, undisturbed woodlands under logs and stones and along small woodland streams	No	Poor surface water quality	Yes; if surface water is improved; forest buffer is left and colonizing population exists nearby
Bird-voiced tree frog	*Hyla avivoca*	RFSS, ST	Bald cypress-tupelo swamps; wet hardwood forests	Yes		Yes; if forest buffer is left; IDNR has found gray tree frogs and other ranids here
(Northern) copperbelly water snake	*Nerodia erythrogaster neglecta*	RFSS	Small, shallow, ephemeral woodland ponds	No	Poor water quality; little food (fish, frogs, tadpoles)	Yes; if colonizing population exists
Timber rattlesnake	*Crotalus horridus*	RFSS, ST	Dry, rocky forests where grasses dominate the herb layer	Yes		Yes; found in forest and in INHD for Williamson County
River cooter	*Pseudemys concinna*	FL, SE	Backwaters of oxbow lakes, large rivers, streams and reservoirs	No	Poor water quality	Yes; if colonizing population exists

Table F-3: Continued

Common Name	Latin Name	Status	Community Types	Suitable Habitat Present	Reason for Exclusion	Potential to Inhabit Area With No AMD and Restoration
Eastern ribbon snake	*Thamnophis sauritus*	FL, SE	Lowland forests, in vegetation along banks of sloughs, cypress-tupelo swamps, wet meadows and other similar areas	Yes	Poor water quality	Yes; if colonizing population exists
BIRDS						
Bald eagle	*Haliaeetus leucocephalus*	T	Found in terrestrial and aquatic areas; nests commonly near water in trees, cliffs, snags; usually undeveloped areas	Yes		Yes; found in INHD for Williamson County
Least tern	*Sterna antillarum*	E	Pebbly, sandy beaches and channel islands; frequents gravel pits and landfills along rivers; nests on broad, flat open sandy beaches	No	No nesting habitat	Unlikely; may use area for foraging if water quality is restored
Short-eared owl	*Asio flammeus*	SE	Large grasslands (greater than 250 acres) or emergent wetland habitat or smaller fragments surrounded by pine plantations	Yes		Yes; if habitat is maintained and native grasses planted
Barn owl	*Tyto albo*	FL, SE	Open country, woodland edges; roosts in barns, tree cavities and silos	Yes		Yes; found in INHD for Williamson County
Northern harrier	*Circus cyaneas*	SE	Open grassland; fresh, brackish, or salt marshes; swamps; bogs; wet meadows; feeds in fields and open country	Yes		Yes; if grassland maintained
Cooper's hawk	*Accipiter cooperii*	FL	Nests in coniferous or deciduous forests and wooded streams; feeds in wide variety of open habitats	Yes		Yes; if riparian forest buffer maintained/pines maintained
Sharp-shinned hawk	*Accipiter striatus*	FL	Nests in conifers or mature woods; prefers open woodland edges, clearings, brushy pastures and shorelines	Yes		Yes; if riparian forest buffer, grasslands and conifers maintained
Red-shouldered hawk	*Buteo lineatus*	FL, ST	Lowland deciduous forests and forested wetlands; uses low wetland habitats for nesting	Yes		Yes; found in INHD for Williamson County
Yellow-crowned night heron	*Nyctanassa violacea*	FL, SE	Wetland, open water	No	Poor water quality	Yes; if no AMD
Bewick's wren	*Thryomanes bewickii*	FL, SE	Open woodlands, upland thickets and hills, some rock outcrops and cliffs surrounded by woods	Yes		Yes; found in INHD for Williamson County
Brown creeper	*Certhia familiaris*	FL, ST	Favors mixed woods; prefers spruce and firs for breeding	Yes		Yes; if mixed woods are maintained
Mississippi kite	*Ictinia mississippiensis*	FL, SE	Nests in river bottom hardwoods; found	Yes		Yes; if riparian forest

Table F-3: Continued

Common Name	Latin Name	Status*	Community Types	Suitable Habitat Present	Reason for Exclusion	Potential to Inhabit Area With No AMD and Restoration
			along streams and rivers; forages over fields and marshes			maintained
Henslow's sparrow	*Ammodramus henslowii*	RFSS, SE	Moist grasslands rarely less than 250 acres	Yes		Yes; if grasslands maintained and native grasses planted
Cerulean warbler	*Dendroica cerulea*	RFSS	Mature, healthy forests	No	No existing old-growth, mature forests	No; requires old-growth forests and forest-interior habitat not found in small land parcels
Migrant loggerhead shrike	*Lanius ludovicianus migrans*	RFSS, ST	Open habitats with thorny shrubs	Yes		Yes; if openings maintained
Swainson's warbler	*Limnothlypis swainsonii*	RFSS, SE	Bottomland hardwood forests, swamps, and ravines	Yes		Yes; if riparian forest maintained
MAMMALS						
Gray bat	*Myotis grisescens*	E	Found only in caves and cave-like habitats within 1 km of river or reservoir	Yes		Yes; found on Shawnee National Forest
Indiana bat	*Myotis sodalis*	E	Wooded or semi-wooded areas along streams; cavernous limestone areas or exfoliating trees for hibernation	Yes		Yes; found on Shawnee National Forest
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	SE	Prefers forested regions; uses caves to hibernate and brood young; also found in abandoned mines, tree hollows, and buildings	Yes		Yes; if colonizing population exists
Southeastern myotis	*Myotis austoriparius*	RFSS, SE	Found in mines and hollow trees near bodies of water; roosts in caves and buildings	Yes		Yes; found on Shawnee National Forest
River otter	*Lutra canadensis*	FL, SE	Perennial streams and riparian forested areas	No	Poor water quality	Yes; if no AMD and local colonizing population exists

Table F-3: Continued

Common Name	Latin Name	Status*	Community Types	Suitable Habitat Present	Reason for Exclusion	Potential to Inhabit Area With No AMD and Restoration
Bobcat	*Lynx rufus*	FL	Dense brush, rocky outcrops; avoids deciduous forest in winter	Yes		Yes; if disturbance/recreation kept to minimum
Golden mouse	*Ochrotomys nuttalli*	FL, ST	Densely forested woodlands and floodplains as well as pine uplands on sandy soils with large amount of understory	No	Fragmentation of woodlands throughout area by mining and agriculture	Yes; found in INHD for Williamson County
Marsh rice rat	*Oryzomys palustris*	FL, ST	Wet meadows and marshy areas with grasses and sedges; occasionally found in dense forest	Yes		Yes; found in INHD for Williamson County

* E = Federally Endangered
T = Federally Threatened
SE = State Endangered
ST = State Threatened
RFSS = Regional Forester Sensitive Species
IDNR = Illinois Department of Natural Resources
INHS = Illinois Natural History Survey (Collections)
INHD = Illinois Natural Heritage Database

Table F-4: Federal Listed, State Listed, and Regional Forester Sensitive Fauna Species of the Shawnee National Forest: Palzo Mine Site Survey Recommendations

Common Name	Latin Name	Status*	Community Types	Resident/ Migrant	Seasonal Patterns	Surveying Recommendations
CRUSTACEANS/ MOLLUSCS						
Carinate pillsnail	*Stenotrema (=Euchemotrema) hubric*	RFSS	Limestone bluffs of SW Illinois and surrounding forest; land snail	Resident	Not known	Visual surveys in forests after rain events or in evening dew; subterranean catchment traps
INSECTS						
Cobweb skipper	*Hesperia metea*	ST	Powerlines, clearings, woodland edges and brushy places	Resident	Caterpillars transform into butterflies in late March	Visual in flight surveys from late March to early June; mist netting
AMPHIBIANS/REPTILES						
Bird-voiced tree frog	*Hyla avivoca*	RFSS, ST	Bald cypress-tupelo swamps; wet hardwood forests	Resident	Breeding March to September	Night time chorus surveys in wet areas from March to September; can be found in tree tops during the day
Timber rattlesnake	*Crotalus horridus*	RFSS, ST	Dry, rocky forests where grasses dominate the herb layer	Resident	Active from April to October	Visual surveys during the day in spring and fall and at night during summer
Eastern ribbon snake	*Thamnophis sauritus*	FL, SE	Lowland forests, in vegetation along banks of sloughs, cypress-tupelo swamps, wet meadows and other similar areas	Resident	Active April to October	Visual surveys in low wet places during active season
BIRDS						
Bald eagle	*Haliaeetus leucocephalus*	T	Found in terrestrial and aquatic areas; nests commonly near water in trees, cliffs, snags; usually undeveloped areas	Migrant	Migrates to find seasonal food; is resident in some areas	Visual surveys over open water areas during January and February

Table F-4: Continued

Common Name	Latin Name	Status*	Community Types	Resident/ Migrant	Seasonal Patterns	Surveying Recommendations
Least tern	*Sterna antillarum*	E	Pebbly, sandy beaches and channel islands; frequents gravel pits and landfills along rivers; nests on broad, flat open sandy beaches	Migrant	Winters south of the U.S.; Breeds from May – July (possibly August if clutch fails); departs by early September	Visual surveys for individuals; surveys for nests on open, sandy beaches along rivers
Short-eared owl	*Asio flammeus*	SE	Large grasslands (greater than 250 acres) or emergent wetland habitat or smaller fragments surrounded by pine plantations	Migrant	Migrates north to breed in spring; arrives late fall and winters in S. IL	Visual surveys in fall and winter (commonly feeds at dusk and dawn over open, wet areas); night calling surveys
Barn owl	*Tyto albo*	FL, SE	Open country, woodland edges; roosts in barns, tree cavities and silos	Resident	Commonly breeds in spring, but can breed all year long	Night calling surveys in open country/woodland edges
Northern harrier	*Circus cyaneas*	SE	Open grassland; fresh, brackish, or salt marshes; swamps; bogs; wet meadows; feeds in fields and open country	Migrant	Fall, winter and early spring resident in S. IL; may migrate further north from late April – August; breeds in May	Visual surveys in fall, winter, and early spring during the day over marshes and open fields
Cooper's hawk	*Accipiter cooperii*	FL	Nests in coniferous or deciduous forests and wooded streams; feeds in wide variety of open habitats	Resident (N. birds migrate south)	Full year resident in IL; breeds in May	Visual surveys year round; feeds over open fields/broken woodlands; nests in trees in May
Sharp-shinned hawk	*Accipiter striatus*	FL	Nests in conifers or mature woods; prefers open woodland edges, clearings, brushy pastures and shorelines for feeding	Federal migrant/ resident in IL	Full year resident in IL/ breeds from May – mid July	Visual surveys during day in nesting and feeding areas

Table F-4: Continued

Common Name	Latin Name	Status*	Community Types	Resident/ Migrant	Seasonal Patterns	Surveying Recommendations
Red-shouldered hawk	*Buteo lineatus*	FL, ST	Lowland deciduous forests and forested wetlands; uses low wetland habitats for nesting	Federal migrant/ resident in IL	Full year resident in IL/ breeds from May – mid July	Visual surveys during day in forested wetlands and lowland forests
Bewick's wren	*Thryomanes bewickii*	FL, SE	Open woodlands, upland thickets and hills, some rock outcrops and cliffs surrounded by woods	Federal migrant/S IL resident	Full year resident in S IL; breeds May – mid July	Breeding bird surveys from May – mid July (visual and song/calls); limited by presence of Carolina and house wrens; nests close to ground
Brown creeper	*Certhia familiaris*	FL, ST	Favors mixed woods; prefers spruce and firs for breeding	Resident (N. birds may migrate south)	Year long resident in IL; breeds May – June	Breeding bird surveys in mixed woods and fir/spruce forests; often nests under loose bark low on trunk of conifer/deciduous trees
Mississippi kite	*Ictinia mississippiensis*	FL, SE	Nests in river bottom hardwoods; found along streams and rivers; forages over fields and marshes	Migrant	Winters in Central and South America; spring through fall U.S. resident	Breeding bird surveys; nests in river bottom hardwoods
Henslow's sparrow	*Ammodramus henslowii*	RFSS, SE	Moist grasslands rarely less than 250 acres	Migrant/ probable year long resident in S IL	Probable year long resident in S. IL/ casual winter resident; breeds May - July	Breeding bird surveys; nests and feeds in herbaceous ground cover (secretive); sings from April to September on quiet nights
Migrant loggerhead shrike	*Lanius ludovicianus migrans*	RFSS, ST	Open habitats with thorny shrubs	Migrant/ year long resident in IL	Breeds twice from April to July	Breeding bird surveys; hunts from exposed perches in open habitats; impales vertebrate prey on thorns, barbed wire etc

Table F-4: Continued

Common Name	Latin Name	Status	Community Types	Resident/ Migrant	Seasonal Patterns	Surveying Recommendations
						(aka butcher bird)
Swainson's warbler	*Limnothlypis swainsonii*	RFSS, SE	Bottomland hardwood forests, swamps, and ravines	Migrant	Winters south to Mexico and Cuba; breeds May to July	Breeding bird call/song surveys (seldom seen); spends most of time foraging for insects on ground
MAMMALS						
Gray bat	*Myotis grisescens*	E	Found only in caves and cave-like habitats within 1 km of river or reservoir	Resident	Roosts mostly in caves in summer and winter (some variety in summer); mates in fall; hibernates in winter; births in June	Night mist netting surveys in summer along riparian areas, lakes and ponds
Indiana bat	*Myotis sodalis*	E	Wooded or semi-wooded areas along streams; cavernous limestone areas or exfoliating trees for hibernation	Resident	Roosts in caves and trees in summer; hibernates in caves in winter; Feed until November; emerges late March	Night mist netting surveys in summer along riparian areas; roost in trees in summer during the day
Rafinesque's big–eared bat	*Corynorhinus rafinesquii*	SE	Prefers forested regions; uses caves to hibernate and brood young; also found in abandoned mines, tree hollows, and buildings	Resident	Hibernates in caves in winter; more transient in warm months	Night mist netting near bodies of water
Southeastern myotis	*Myotis austoriparius*	RFSS, SE	Found in mines and hollow trees near bodies of water; roosts in caves and buildings	Resident	Hibernates in caves in winter; roost in variety of places	Night mist netting near bodies of water

Table F-4: Continued

Common Name	Latin Name	Status*	Community Types	Resident/ Migrant	Seasonal Patterns	Surveying Recommendations
Bobcat	*Lynx rufus*	FL	Dense brush, rocky outcrops; avoids deciduous forest in winter	Resident	Breeding early Jan – March;	Night surveys; during day lies up in rock clefts, thickets or other hiding places; can be tracked especially well in winter; survey for scent and scratching posts; scat etc.
Golden mouse	*Ochrotomys nuttalli*	FL, ST	Densely forested woodlands and floodplains as well as pine uplands on sandy soils with large amount of understory	Resident	Breeds mid March through October	Breeding surveys; nests are large, globe shaped and usually in green briar thickets; largely arboreal – runs high in the branches
Marsh rice rat	*Oryzomys palustris*	FL, ST	Wet meadows and marshy areas with grasses and sedges; occasionally found in dense forest	Resident	No known seasonal patterns; appears to breed year round (lower rates in warm months)	Visual surveys; most abundant in marshes and wet meadows; builds nests in emergent vegetation above high water level

* E = Federally Endangered
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SE = State Endangered
ST = State Threatened
RFSS = Regional Forester Sensitive Species
INHS = Illinois Natural History Survey (Collections)
INHD = Illinois Natural Heritage Database